TREASURY DEPARTMENT - UNITED STATES COAST GUARD

BULLETIN No. 15

INTERNATIONAL ICE OBSERVATION AND ICE PATROL SERVICE IN THE NORTH ATLANTIC OCEAN - [SEASON of 1926]

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ICE OBSERVATION AND ICE PATROL SERVICE

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NORTH ATLANTIC OCEAN

Season of 1926

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1927

SOURCE OF ICE-BERGS AND THEIR DRIFT INTO THE NORTH ATLANTIC.

PLATE I

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FOREWORD

The London Convention of 1914, the recommendation of which paved the way for the United States to undertake the direct operation of a patrol of the ice regions of the North Atlantic, also went on record in favor of a scientific program and the publication annually of a report of the patrol work. In accordance with the latter feature a bulletin has been published after the expiration of each one of the patrols since 1913.[1] The bulletin herewith follows the customary arrangement of the subject matter of those appearing in former years. First comes the general program and statement of policies which have in the past 13 years become pretty well established. Then follows a narrative of the events which occurred during a total of the seven cruises that made up the patrol for 1926. A brief account is given of the radio operations for the season, a subject which obviously is a vital one when estimating the patrol's efficiency. The oceanographic work this season was featured by the application of new and progressive methods[2] to map the currents in the so-called critical area around the Tail of the Grand Banks.

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[1] Copies are obtainable free of charge from Commandant, U. S. Coast Guard, Washington, D. C.

[2] Smith, Edward H.: "A Practical Method for Determining Ocean Currents." U. S. Treas. Dept. Bull. No. 14.

THE INTERNATIONAL ICE PATROL

1926

The International Ice Patrol for the season of 1926 was carried on by the United States Coast Guard cutters *Tampa* and *Modoc;* the former was in command of Commander H. G. Fisher, and the latter was in command of Commander H. H. Wolf. The Coast Guard cutter *Mojave* was designated as the stand-by vessel. Lieut. Commander Edward H. Smith, was detailed to assist and advise the commanding officers while on patrol.

As in former years the object of the patrol was to locate by scouting, and radio information, the icebergs and ice fields nearest to and menacing the North Atlantic lane routes. In doing this it was necessary to determine the southerly, easterly, and westerly limits of the ice and to keep in touch with it as it moved southward. Radio broadcasts were sent out twice daily giving the whereabouts of this ice and particularly that which was in the immediate vicinity of the North Atlantic lane routes. In order that an intelligent service of the highest degree be rendered to shipping, an oceanographic program was laid down the results of which, it was hoped, would furnish the vessel on patrol with a practical up-to-date current map of the critical, infested ice area under surveillance. The oceanographic work being supportative and secondary in importance was so arranged that it would not hamper the patrol in its primary duty of ice scouting.

A scientific program from which conclusions of practical value may be drawn is an established policy of the ice patrol. The work carried out in 1926 progressed along two general lines:

(*a*) Sonic depth recorder experimentation. The ice patrol was equipped with one sonic depth recorder in 1925 in order that experimental tests be carried out which might lead to the design of a practical device for determining the proximity of bergs not visible because of fog, snow, or darkness. It was found impossible to continue with this phase of the sonic work in 1926, but about 450 hydrographical soundings were taken in order that an accurate and authenic map of the ice regions around the Grand Banks may ultimately result. (See pp. 49 to 52.)

(*b*) Oceanographic work: If the patrol had knowledge of the drift tracks which bergs would follow after arrival at the Tail of the Grand

Banks, more valuable information could be furnished approaching vessels, especially during the protracted periods when fog enshrouds the cold-water regions. Since nearly all the bergs at this gateway to the Atlantic are controlled by a relatively deep-seated circulation, a current map of the critical area where the Labrador current and the Gulf Stream meet, is an indicator of the courses menacing bergs will follow. A practical means of determining oceanic circulation in critical areas was instituted for the first time with the season of 1926. (See pp. 108 to 117.) The methods of this work [1] are set forth in a pamphlet recently published by the Coast Guard.

After the ice was located the patrol began transmitting four daily radio broadcasts, giving ice information for the benefit of shipping, each broadcast being repeated once with an interval of two minutes between the messages. The times at which these broadcasts were sent and also the wave lengths used are given below:

Greenwich civil time	Time seventy-fifth meridian	Wave length	Frequency
		Meters	*Kilocycles*
0000	1900	1,713	175
1100	0600	706	425
1200	0700	1,713	175
2300	1800	706	425

In addition to this service ice information was given to any ship that made inquiry and in cases where vessels were standing dangerously close to ice, the patrol sent them a special message.

The ice patrol in transmitting routine dispatches to Washington operated under the following schedule which had been arranged before the ships sailed from port. After getting the "XA" set in working order a slightly modified schedule superseded the one here. (See p. 16.)

Greenwich civil time	Time, seventy-fifth meridian	
1300	0800	Ice patrol transmits Weather Bureau report to Bar Harbor on 175 kilocycles (1,713 meters), using the "no answer" method.
1700	1200	Washington transmits "no answer" method acknowledgement for 0800 schedule on 113 kilocycles (2,650 meters).
1800	1300	Ice patrol receipts by "no answer" method to Bar Harbor receipt for Washington's 1200 schedule. Use 175 kilocycles (1,713 meters).
0100	2000	Ice patrol transmits "no answer" method to Bar Harbor on 175 kilocycles (1,713 meters), dispatch for Weather Bureau and Hydrographic Office.
0300	2200	Washington transmits "no answer" method acknowledgement for 2200 schedule on 113 kilocycles (2,650 meters).
0330	2230	Washington transmits "no answer" method, a weather forecast for the ice patrol, 113 kilocycles (2,650 meters).
0400	2300	Ice patrol receipts by "no answer" method to Bar Harbor for Washington's 2230 and 2300 schedules.

[1] Smith, Edward H.: "A Practical Method of Determining Ocean Currents." U. S. Treas. Dept. Bull. No. 14.

A more detailed account of the radio activities for the season of 1926 are contained in the section devoted to radio communications, page 14.

A full and detailed description of the behavior of icebergs in the currents in 1926, together with illustrated sketches is contained on pages 53 to 77.

The principal features of the ice patrol season of 1926 have been taken from the detailed reports covering the seven cruises that were made, and this narration forms the first section of this bulletin.

The detailed discussion of the weather, ice observation, results of sonic sounding work, and the oceanography have been grouped together in sections that follow consecutively throughout the bulletin.

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CRUISE REPORTS

THE FIRST CRUISE, "TAMPA," MARCH 25 TO APRIL 11, 1926

In accordance with headquarters telegram the *Tampa* sailed from Boston at 11.55 on the morning of March 25, 1926, and stood out to sea setting a course from the harbor entrance for the Tail of the Grand Banks. Thus was inaugurated the season of 1926. On the second day out we received the first steamer's report of icebergs which referred to a group of seven located on the eastern part of the Grand Bank between latitudes 45° and 43° 30′. This same information was contained in the radio broadcast from Arlington and so it was thought to be the real reason for dispatching the first of the patrol ships to the ice regions.

Sunday, which was our fourth day out, found us about 200 miles west of the Tail of the Grand Banks and there we stopped for an hour to take the first oceanographic station of the year (No. 554), and especially to give new members of the *Tampa's* crew an opportunity during good weather and daylight, to see the manner in which the station work is performed. In the afternoon dispatches were addressed to the wireless officer, Halifax, Nova Scotia, officer in charge compass station, Cape Race; commercial radio station, Cape Race; and the French radio station at St. Pierre, informing them all that the ice patrol ship had now arrived in the ice regions and the same service as rendered to shipping in previous years would be carried out.

Early in the morning of March 29 we arrived at the position of oceanographic station No. 555, located about 75 miles off shore of the southwestern edge of the Grand Banks. It was blowing with gale force at the time and in order that an up-and-down cast be secured the vessel was maneuvered head to the wind and sea with sufficient headway only to prevent her from "falling off." A careful and quick management of the helm under such conditions is necessary, but the maneuver was easily affected and the sounding work carried out with excellent results. When the third station, this same day, however, was to be taken just south of the Grand Banks, it was found that the oceanographic electric winch was burned out. More careful investigation proved the trouble to be so serious that the oceanographic program for the remainder of the cruise would have to be abandoned. Added to this information came the news that the motor starter of the sonic depth finder had broken. New parts for both these defective ones were the subject of dispatches sent to Washington that night.

An eventful day was March 31 when at 1.55 p. m. we received an S O S flashed from the steamer *Laleham*, without lifeboats and foundering in latitude 39° 06′, longitude 56° 42′. We immediately headed toward the spot and increased speed but other ships (including the *Mauratania*) much nearer responded to the call. At 9 a. m. the steamship *Shirvan* reported having completed the rescue of the crew, so we headed back toward the Tail of the Bank. On account of the S O S call no evening ice broadcast was sent, this being the first time in the history of the ice patrol that such a situation has arisen.

Easter Sunday dawned bright and clear, decidedly the best day experienced so far on the cruise. We started early in the morning searching northward along the eastern side of the Banks, 10 miles seaward of the 100-fathom contour, in a zone which has come to be recognized as the heart of the cold current which bears the freight of ice southward. And so it proved this day, for at 2.45 o'clock in the afternoon the patrol sighted the first ice of the season in the form of broken Arctic fields. The position of this southern tongue was recorded as latitude 43° 59′, longitude 48° 55′. The next morning we ran up to the edge of the ice and from sights found that it had drifted southward during the night at the rate of 1 knot per hour. We steamed about 30 miles northward inshore of the ice skirting its western limits, and returned before nightfall to a position southward of the southern edge. This ice had a very short survival for on the 8th we searched this same area and nothing of it could be seen.

The first and only bergs sighted on the first cruise were raised by the masthead lookout about 2 p. m. on April 9. There were three small bergs in latitude 44° 10′, longitude 47° 51′, which were drifting northeastward at the rate of 0.7 knots per hour. The fact that this ice of small size was floating in water with a temperature of 51° F. (the northern edge of the Gulf Stream), coupled with the report that the *Modoc* was standing eastward to relieve, caused us to head westward this same night and the following day.

The *Tampa* was relieved of the patrol duty the morning of April 11 just to the westward of the Tail. During the cruise we received eight reports of ice from passing vessels; furnished ice information to four ships and received a total of 617 reports of sea-water temperatures.

THE SECOND CRUISE, "MODOC," APRIL 11 TO 25, 1926

After relieving the *Tampa* the *Modoc* was anchored temporarily in on the Grand Bank, but the wind began to freshen on April 12 and before daylight it was found more comfortable to get under way and head into a moderate westerly gale. The day was spent in this manner with sufficient steerageway only to hold the ship's head up to wind and sea. Due to the fact that we were on the shallowest part of the Bank, the waves were very short and "cobbly," and one sea larger than the others caught our starboard bow just at the right moment, breaking on board and washing a deck box aft beyond the galley. It also bent over and fractured a stanchion which held the forward part of a small canvass awning spread between the cabin and rail. Under such weather conditions as prevailed this day any plans for carrying on a program of ice scouting were forced to be postponed.

April 13 provided better weather and so a start was made to search part of the icy current. At 3 o'clock in the afternoon we reached a position for heading northward along the eastern edge of the Bank, and we paused long enough to hold memorial services for the *Titanic* dead. This ceremony has now become a more or less established custom of the ice patrol vessel each year, and as usual a message was broadcasted to passing ships requesting them to observe a respectful silence from 0700 to 0715 Greenwich civil time, while the actual rites were being paid on the *Modoc*. Early this morning the steamer *Alaunia* informed us that she was stuck fast in an ice field which was located to the south and west of the entrance to the Gulf of St. Lawrence (Cabot Strait). Later this same day this ship discovered a lead and freed herself in open water. Everything was all right with the *Alaunia* when on April 14 she sent the patrol a radio that she had left behind the last of the St. Lawrence fields and was then proceeding eastward past Cape Race.

The *Modoc* made an excursion to the eastward of the Grand Banks on the 14th to the 17th in search of three small bergs reported by a passing vessel. The cruise was a fruitless one as the ice was not located. A great deal of fuel was expended in returning to the westward because of bucking the strong westerly gales and mountainous seas. We finally reached the east edge of the Bank on the 19th instant where the ship remained anchored for the next four days.

The weather made a change for the better on the 22d which was in agreement with the atmospheric pressure distribution as outlined on the meteorological map. This plainly indicated that the pressure gradients were quite small and the progressive movements of the centers of low pressure were relatively slow. All of this pointed toward the advent of summer time conditions and marked a great change from the weather that had prevailed since the inauguration of the patrol. Many reports were received this day from ships on track E bound for St. Lawrence ports. As they crossed from the deep water of the Atlantic on to the continental shelf they sighted considerable ice, all of which has been listed in detail in "Table of ice and of other obstructions," pages 21 to 30.

The *Modoc* had an opportunity on the 23d instant to search northward along the eastern edge of the Bank for menacing ice. We proceeded northward as far as the forty-fifth parallel but found nothing. We could do nothing more in this line because of foggy conditions, so on April 24 the ship was headed westward in order to meet the relief. The *Tampa* was met about 4 in the afternoon of the 25th. During this cruise the *Modoc* received a total of 53 reports of ice sighted by passing vessels, furnished information to 16 ships, and received a total of 950 reports of sea water temperatures.

THE THIRD CRUISE, "TAMPA," APRIL 25 TO MAY 10, 1926

After effecting the relief and assuming the duties of patrol ship the *Tampa* was kept off on a course for the first one of several oceanographic stations arranged in positions around the Bank in accordance with a previously arranged program. In view of the fact that no ice was south of the forty-fifth parallel and also that there had been considerable postponement in the oceanographic work, the patrol decided the work better be commenced while opportunity existed. Bergs, moreover, were to be expected soon invading the waters around the Tail and it was desirous that the patrol vessel have on board a current map of this critical area.

The next nine days were mostly devoted to collecting data of temperature and salinity from several depths at stations scattered netlike around the Grand Banks. During this period the work was delayed by the presence of a fog and near the latter part of the investigation a strong westerly gale was encountered. While heading the gale on the 2d of May a report was received from the steamship *Rousillon* regarding the position of an iceberg on the east side of the Bank in latitude 44° 10′. This was without doubt one of a group of five bergs that had previously been reported by Cape Race track steamers but it was the southernmost berg so far for 1926 and in that respect was a point of interest for the patrol.

A fog prevented us searching for this berg and so we waited until conditions became clearer. During this period the oceanographer with the data collected calculated the direction and rate of flow of the water in the regions surveyed and a map of the currents was drawn and posted for the information of those in charge of the patrol work. This is the first time in any expedition that the results have been immediately determined on board ship for practical employment.

May 7 the *Tampa* was near the fishing fleet and one vessel was spoken and another was boarded. Sea stores were traded for fresh fish and we anchored for the night in on the Bank. The oceanographer gave a 15-minute talk this same evening on the history of the ice patrol and general behavior of Arctic ice south of Newfoundland.

Nothing could be done during the day of the 8th on account of fog but the 9th it cleared, the very same day that the patrol ships were meeting on the southwest side of the Bank. Two reports were received from steamers on the east of the slope which had sighted bergs and which plainly indicated that the ice was beginning to drift southward around the Tail. The *Tampa* during the third cruise for the season covered about 1,255 miles, and took 24 oceanographical stations. There were 54 ice reports received and 9 ships were given special ice information. A total of 835 surface temperature reports were contributed by passing vessels. We requested that 22 steamships give receipted acknowledgment for the ice broadcast because their courses were laid near the ice danger zone.

THE FOURTH CRUISE, "MODOC," MAY 10 TO 25, 1926

The *Modoc* met the *Tampa* the morning of May 19, 120 miles west of the Tail, where the oceanographic party was received on board and the relief effected. As soon as the boat was hoisted the *Modoc* was headed eastward with plans to search the region around the Tail the next day. Unfortunately a dense fog shut in before the close of the day which necessarily suspended all searching work. Foggy conditions continued for the next two days but about 5 o'clock the afternoon of the 12th the wind shifted to the westward during a rain squall and the blanket of fog was swept away. We were not slow to take advantage of such ideal conditions and for the next 36 hours conducted a search which led as far north as the 43° 30′ parallel. There were four bergs found in the searched area, the southernmost one on the forty-third parallel in the heart of the Labrador current drifting south-southwest at the rate of 0.8 knots per hour.

The scouting work on the 14th instant revealed more ice than the patrol had found heretofore this year. There were a total of 21 bergs found south of latitude 44° 15′ which was fartherest north for the trip. This ice was strung out along the eastern edge of the Bank and in positions which indicated that the bergs were tending to set on shore and strand. Many of the bergs had growlers near them and it was observed, moreover, that there were no extraordinary large bergs sighted. The rate of drift was estimated at 1.1 knots per hour.

Fog shut in again on the 15th and lasted with occasional brief "light ups" until May 20. During this time the *Modoc* steamed over an area lying off the southwest slope and around the Tail where a total of 12 stations of salinity and temperature were occupied A current map was constructed upon the basis of these data and the bergs which had been lost in the fog were thought to have drifted either up on the southwest slope of the Bank or to the northeast in the counterset. In any event the current map showed that there was very little likelihood to suppose that the ice had been transported southward in the fog toward the steamship lanes.

Late in the afternoon of the 20th the steamer *Tiger* sighted 20 bergs off the Tail about 30 miles and so during the night we shaped a course so as to be in an advantageous position to commence searching at daylight on the 21st. During the next two or three days the patrol searched this entire area and plotted the positions of a total of 20 bergs and three growlers. As this discussion with sketches is taken up on page 65, it will not be entered upon here. On the 23d it was observed that the bergs farthest offshore to the southeast were slowly being turned in the current and were beginning a counter drift to the northeast. Later in the morning the *Modoc* laid a course to the southward and westward because no chances wished to be taken on bergs drifting unawares in that dangerous direction. While we were steaming in this quarter a fog bank rolled in completely enveloping the ice infested waters.

The approach of the *Tampa* returning for a new tour of duty was announced by radio the night of the 23d and so we headed over to the westward, meeting at a rendezvous about 100 miles west of the Tail. The *Modoc* received 67 reports of ice sighted by passing vessels, furnished ice information to 10 ships, requested acknowledgment from 22 vessels for the regular ice broadcast, and received 775 surface temperature reports during the cruise thus terminated.

THE FIFTH CRUISE, "TAMPA," MAY 25 TO JUNE 10, 1926

After relieving the *Modoc* the *Tampa* stood eastward toward the group of bergs last seen by the *Modoc* on the 23d instant but fog shut in the morning of the 26th causing us to drift until the arrival of clear weather again. Sometime during the morning we received a radio from the steamer *Clearpool* reporting a berg and growler in latitude 41° 49′, longitude 50° 12′. We immediately requested the master of the *Clearpool* to verify his position and indicate how recently he had obtained astronomical sights, because this position was considered surprisingly far south for any berg to drift so quickly. The reply stated that the previous position was in error and gave the latitude as 42° 24′. The *Tampa* got under way and had not proceeded very far when a growler was sighted close aboard in the fog. This we thought might be the same growler that the *Clearpool* had seen earlier in the day, so taking it as a point of departure we headed eastward about 10 miles where a berg was found. When the fog cleared later on we beheld five bergs in sight to the eastward, and so we steamed over to the largest one. This group of bergs was undoubtedly part of the same ice which the *Modoc* located to the northeastward on the last cruise.

The fog cleared up for good on the morning of the 27th and gave us an opportunity not only to locate all the bergs in this region south of the Tail but also permitted of securing accurate sights. We had been without a definite fix of the ship's position for nearly four days. Ten bergs were sighted during the day, five in the dead water directly south of the Tail, latitude 42° 27′; two lay to the westward on about the same parallel but in longitude 51°; and three more bergs were observed grouped together at the farthest point south for the year, viz, latitude 42° 13′ longitude 50° 29′. The distribution of this last lot was in agreement with the oceanic circulation as determined May 18–20 by the *Modoc*. The bergs in longitude 51° 00′ had drifted as far west as was possible on account of the counterset in that region, while the three southern ones had become caught in the inshore edge of the easterly flowing water and they were drifting east-southeastward at the rate of 0.5 of a knot per hour.

On May 28 a message was received from the steamship *Chicago* reporting a berg in latitude 41° 51′, longitude 48° 33′; this being the southernmost ice and only about 20 miles north of the westbound steamer track, the *Tampa* was headed on an easterly course in order to get in touch with this ice as soon as possible. At daylight on the 29th we sighted the berg for which we were in search. It was not a very large berg, in fact it was medium to small and it showed signs of rapid disintegration. During the morning and afternoon demolition operations were carried on, making use of 6-pounder gun and 238-pound TNT mines. Considerable ice was shaken down but it is questionable whether the expenditure would be justifiable in continuing such a practice on a greater scale. That evening we spent close to the ice warning all approaching ships of its location.

The next day our berg was only about half of its former size. The rapid disintegration was due without doubt to a heavy swell which continually washed the ice and broke off growlers one after another. The temperature of the water, 56°, of course also materially assisted to speed up the melting processes, and so May 31 witnessed the entire removal of this menace to navigation. This was the most rapid disintegration of which the patrol has record, to the best of our knowledge, and it is of interest because it was due in a great measure to the swell and sea which continually lashed and strained the berg. At 12.30 p. m. there was no longer any reason for remaining in the locality—latitude 40° 45′, longitude 47° 38′—so we steamed ahead on course 310° toward the group of five bergs which we had left on the 28th instant.

About 7 o'clock the morning of June 1 the steamer *Stadsdijk* reported seeing two bergs about 30 miles to the westward of where we were searching and this ice was believed to be the same that we wished to sight. The course was accordingly changed for this new position and at the same time radiocompass bearings were taken of the *Stadsdijk*. While we were maneuvering to get in touch with this ice a message was received from the steamship *George Washington* that she had just passed a small berg about 35 miles to the eastward of where we were then and on the westbound steamer track. We immediately headed that way, made contact with the *Washington* at 11 o'clock, and picked up the berg just before sunset.

The *Tampa* remained close to this berg during the next four days, as long as it continued to be a menace to navigation. During the nighttime it was our practice upon the approach of steamers to throw the searchlight beam on the ice clearly marking its position. That this was appreciated is shown by the following message from the steamship *Mauretania*, which passed close to the *Tampa* one night. "We are passing south of you; can see berg in your searchlight beam. Thank you. Rostron."

A dispatch on June 2 broadcasted from Arlington radio station stated that the trans-Atlantic track conference had decided to change from tracks B to tracks A immediately, the eastbound track being moved June 2 to 39° 30′ latitude, and the westbound track being moved simultaneously to latitude 41°, with the complete shift of the westbound to latitude 40° 30′ on the 9th instant.

On June 4, with the melting of the aforementioned berg, the patrol vessel shifted its position 4 miles to the northward near a large berg which had been sighted the previous day. A survey was made of the exposed surface above water; a tower, the highest point on one end, measured 55 feet; the opposite end, 35 feet; and the length was 382 feet. It is worth mentioning here that the heights of bergs can be measured quite accurately by climbing the mast to a point where the line of sight of the observer passes tangent to the summit of the ice and through the horizon. A correction of 4 feet should be added to this as the correction for the dip of the horizon. Measured heights from the water line can be easily marked upon the mast in units of 5 feet, and it will seldom be found that heights of bergs will exceed the height of the crow's nest.

While the *Tampa* was lying alongside of this ice on June 5 the steamer *Leviathan* passed close aboard about 9 o'clock in the morning. She thanked the patrol for its services and very complimentary added, "Your vigilance was an inspiring sight to everybody on board. Hartley." Captain Fisher replied, "Glad to be of service to the queen of the American merchant marine. Your passing ship was an inspiring and beautiful sight." The early morning hours of June 6 witnessed the complete melting of this ice.

The last few days of the *Tampa's* cruise were spent patrolling along the southern boundary of the fog wall as it was impossible to carry on any ice scouting in the cold waters to the northward. The

Tampa received a total of 970 sea water temperatures from passing vessels; gave special ice information to 10 ships; and received a total of 159 reports of ice. There were 71 ships during the cruise from which we requested acknowledgment of receipt of the ice broadcast.

THE SIXTH CRUISE, "MODOC," JUNE 10 TO 25, 1926

The 11th and 12th were foggy days but June 13 it cleared and the *Modoc* was headed westward in order to get into an advantageous position for searching for any ice south of the Tail of the Bank. Excellent visibility prevailed on the 14th and the *Modoc* for the second day of clear weather was cruised at forced draft over a large area where bergs were suspected. No ice was found, however, and this fact was interpreted as indicating a great dwindling in the number of bergs from the high point earlier in the month. Not over three weeks previously in this same locality there were drifting more than 20 icebergs. A few reports continued to be received from steamers on the Cape Race tracks to the northward.

The 15th of June the *Modoc* spent searching from a point 70 miles west of the Tail along the forty-third parallel to the eastward about 90 miles. No ice was sighted and excellent visibility prevailed the entire day except for a short time in the afternoon. When we attempted to search northward, however, along the eastern slope of the Bank a wall of fog was met. The water along the slope, with a temperature of 46°, was 4° or 5° cooler than any other part of the surrounding surface water.

During the morning of the 16th we made another attempt to search northward along the east edge of the Bank but a heavy fog wall was soon entered which of course precluded all hopes of further ice search. The afternoon and evening were spent occupying a line of oceanographic stations extending south of the Tail, but this work had to be abandoned late at night due to a severe southerly storm and sea.

The storm ended on the 17th as suddenly as it had begun so we were quick to take advantage of the clear visibility searching northward as far as latitude 44° 30′ in the icy current. No ice was found in the current and this was taken as a very hopeful sign that there would be very few bergs able to drift as far as the Tail during the rest of 1926. A small berg was reported well to the northwestward on the southwest part of Bank, however, but its position was not dangerous, and it was believed this ice was the same as that reported on the 13th instant to the patrol, then grounded on the Tail.

We were able to continue the patrol's search on the 18th still farther to the northward, no bergs being found south of parallel 44° 45′. We anchored on the eastern side of the Bank on the 19th and 20th. The steamer *United States* sighted a small berg southeast of the Tail about 20 miles on the 19th but inasmuch as it was not much larger than a growler in size and that it was floating in warm water, temperature 55°, it was not regarded as a potential menace. We searched this vicinity on the 22d, however, the first opportunity of clear weather but nothing was found so the *Modoc* was headed westward for a rendezvous with the relief ship.

There were 144 reports of ice received from passing vessels; 3 steamers were furnished special ice information upon request; and a total of 1,002 reports of surface water temperatures were received.

THE SEVENTH CRUISE, "TAMPA," JUNE 25 TO 30, 1926

After taking over the patrol work from the *Modoc* it was decided best to utilize the time compiling an ocean current map of the region around the Tail of the Bank, in order that a record might be made of the current conditions just before the patrol was discontinued. Stations were occupied along lines normal to the trend of the slope and spaced at intervals of 50 to 75 miles.

This work continued and the 26th found the *Tampa* running northward on a line just south of the Tail. The water temperature wall was found to lie in latitude 41° 55′, longitude 50° 15′, the thermometer dropping from 61° to 57° quite abruptly. The position of the temperature wall at this place refutes the belief that the position of the Atlantic water had been changed much from that found earlier in the season. Such an error of judgment is easily made because of the relatively high temperature of the surface water which is attained solely as an effect of the sun's heat with the approach of summer.

The 27th, 28th, and 29th were spent on oceanographic survey and when the weather was clear advantage was taken to include a search for ice. Not a sign of bergs was found and so a recommendation was forwarded to headquarters that the patrol be discontinued at midnight on June 30. A reply the next day directed the patrol to discontinue its activities at midnight June 30 and return to the United States.

We headed westward on the last day of the month preparatory to returning to Boston. No ice had been reported or sighted by the patrol vessel south of the forty-fourth parallel since June 17 and this area had been repeatedly searched since that date. We were quite confident that no ice could possibly be in these waters. Bergs continued to be reported on the northern part of the Bank and near Cape Race as is usually the case at this time of the year. Messages were dispatched to the wireless officer, Halifax; the officer in charge radiocompass station, Cape Race; and the commercial wireless station, Cape Race, notifying them all of the discontinuation of the ice patrol and thanking them for cooperation during the 1926 season.

During the cruise thus terminated the *Tampa* received 36 reports of ice, furnished special ice information upon request to 1 steamship, and received a total of 186 sea-water temperature reports.

RADIO COMMUNICATIONS

The vital importance of the radio to the plan of an ice patrol warning approaching ships of the dangers in their paths is quite obvious. It would be literally impossible to perform this humanitarian service if it were not for Marconi's pioneer invention. Naturally the efficiency and value of the patrol, as it proportionately assists to increase the safety of life on the North Atlantic, is closely wrapped up in the entire subject of radio. Not only is it the ice which is actually found by the patrol that is reported to shipping, but also is included the ice from a much larger area than that which the patrol could possibly hope to cover. Such accomplishments can only be realized with the cooperative assistance received from passing ships which report to the patrol from positions scattered over the entire danger region. It can be seen that under such circumstances the patrol vessel assumes the rôle of a radio clearing house and thus becomes the disseminator of a digested report for the whole region. The story of the past season's work, as in former years, has been one of willing and efficient service on the part of the merchant vessels. We also want to add that the Canadian direction-finding stations and the Cape Race Commercial Radio Station have done everything possible to make the radio operations run smoothly and successfully. The summary of the work performed during the 1926 season will be found in the report of the ice patrol commander, page 17.

A survey of the radio communications during 1926 particularly impresses us with a feature which excels previous years; and the part we have in mind refers to the great improvement regarding the ship to shore communication. The patrol, in its early years, depended upon forwarding its traffic to Washington via the nearest coastal station, Cape Race, Newfoundland, by means of an ordinary 2-kilowatt spark transmitter. There were, however, times during the first few weeks of the ice season, say until April 1, when direct communication was possible by this means, but for the major part of the season, it was necessary to transmit messages via Cape Race.

Because of the expensive tariffs by this route it has long been the desire to establish official communication between the patrol and naval radio stations situated in the United States. When the then new ships *Tampa* and *Modoc*, in 1922, were assigned to patrol duty, more frequent communication with United States coastal stations was effected by means of arc sets with which these vessels were equipped. This service failed quite often, however, due to summer time static conditions and poor functioning of the sets. Such unsatisfactory conditions caused the officials in charge of the patrol work in 1925 to equip the ships with 2-kilowatt vacuum tube transmitters, especially designed and manufactured by the General Electric Co. (See Ice Patrol Bull. No. 13, p. 51.) Communication by means of these sets with the naval coastal station at Bar Harbor, Me., was more reliable and satisfactory than at any time during patrol history. Summer time static conditions even then, quite frequently in June, necessitated an auxiliary service, communication being effected via the patrol ship off duty in Halifax. Realizing the natural difficulties which the patrol had met for several years with ship-to-shore traffic, a new type of set was installed just before the ships sailed in 1926. This set employs a short-wave, high-frequency transmitter, 35 or 70 meters, and it represents a new design which the United States Navy is manufacturing. In fact the work was rushed in order that the patrol might be equipped for 1926. During the first half of the season minor alterations were found necessary before the best performance was attained, but by the latter part of the patrol the sets were operating satisfactory. Direct communication with the high-frequency sets was maintained with few exceptions the entire patrol of 1926 with the Navy Experimental Laboratory, Bellevue, Md. The set is described as a Navy model "XA," 500-watt crystal control, with a frequency of 4,205 and 8,410 kilocycles, and was manufactured at the laboratory, Bellevue.

The other radio equipment carried on board the ice patrol vessels was the same as that in use during the 1925 patrol. (See Ice Patrol Bull. No. 13, pp. 51–52.) Information regarding the weather was broadcasted every night and morning by means of the 2-kilowatt tube transmitter (C. G. model T–2). Also information of a general character as to the behavior and distribution of ice and currents were "talked" quite informally this past year as the steamers approached the ice regions. The officers of these vessels were especially invited to come to the radio room and listen in and it was apparent that these phone talks were of considerable value. It is human to forget with the passage of time even the lessons learned through great tragedies, and the mariner is no exception to this rule. It is, we believe, part of the spirit of ice patrol, to educate by talks on the entire subject of this danger every spring. The patrol has trained experts and it is certain that their knowledge will be of interest and stimulate educational thought along similar lines with the navigator.

The amount of ice patrol traffic handled by radio is always interesting and indicative of the amount of work performed by that means. There were approximately 5,488 reports received from passing steamers concerning their position, course, speed, and sea water temperature. A total of 470 official messages were transmitted to Washington, and 236 were received. It is estimated that a total of 252,299 words were handled during the season of 1926. (See p. 20.)

There is appended herewith a schedule giving the times at which messages were sent and received by the patrol vessel. The schedule was not adopted until after several preliminary experiments and trials, so that the final draft as outlined here ought to furnish a very good schedule upon which to base radio operations for next year.

(All times seventy-fifth meridian)

0600. Ice broadcast (spark); call on 600 meters then send on 706 meters twice with a two-minute interval.

0700. Ice broadcast (continuous wave); call on 600 meters then send twice on 1,713 meters with two-minute interval.

0800. Send weather report to Bar Harbor, Me., on 1,713 meters, using "no answer" method.

0915. Copy Cape Race weather broadcast.

1030. Copy Arlington weather broadcast.

1200. Copy time signals and ice patrol traffic from Arlington.

1415. Copy weather broadcast from Cape Race.

1800. Ice broadcast (spark); call on 600 meters then send on 706 meters twice with two-minute interval.

1900. Ice broadcast (continuous wave); call on 600 meters then send on 1,713 meters with a two-minute interval.

1930. Clear all ship to shore traffic with Navy Experimental Laboratory, Bellevue, Md., on 35 meters.

2000. Stand-by schedule with Bar Harbor, Me., on 1,713 meters only in case the 1,930 schedule fails.

2115. Copy Cape Race weather broadcast.

2200. Copy time signals and any ice patrol traffic from Arlington.

2230. Copy weather broadcast from Arlington.

SUMMARY REPORT OF ICE PATROL COMMANDER

Commander H. G. Fisher, Commander International Ice Patrol

Ice patrol was inaugurated March 25, when the *Tampa* sailed from Boston for the Grand Banks. The *Modoc* departed from New York in sufficient time to relieve the *Tampa* on April 11, and thereafter these two ships took alternate 15-day tours of duty throughout the ice season. The patrol was discontinued at midnight June 30, having been on guard a total of 97 days.

The ice patrol which is now 13 years of age, has during this period had opportunity to study its problems, and plan its general administration so that now many of the features of the work have become systematized, especially those events which have gradually grown to assume a more or less routine character. The work, as has often been remarked, possesses two main aspects—(*a*) the practical and (*b*) the theoretical. The first (*a*) embraces the primary function of locating by actual scouting and radio communication, the icebergs and field ice nearest to and menacing the North Atlantic lane routes, and the duty of placing that information at the disposal of all approaching trans-Atlantic ships. The second (*b*) centers on carrying out an intelligent scientific program the results of which throw light of practical importance on the economic humanitarian service which the patrol endeavors to render to shipping.

In speaking of the practical work it is customary to include in the summary report of each year a brief review of the distribution of ice in time and place, its drift, numbers of bergs, and a survey of the weather which has been experienced during the season. It may be quite confidently stated that less field ice drifted south of Newfoundland in 1926 than usual. In fact there were very few reports of field ice before the month of March with the flat ice attaining a maximum early in April, and with the last report dated May 11. Even at the date of its most southern extension, April 4 and 5, it did not reach as far as the Tail of the Bank, nor did it spread to any great extent over the Grand Banks south of Newfoundland as it often does. It held, however, more or less closely to the eastern and northern portions of the Grand Bank as usual.

Ice conditions in the Gulf of St. Lawrence this year were very open, the patrol receiving a message from the Canadian ice patrol ship *Mikula* that the gulf and river were navigable to Quebec on April 18, or about one month earlier than usual.

The first icebergs were reported south of Newfoundland in February; the number increased in March. No bergs drifted south of the Tail during April; few during the first half of May; but the latter half of that month saw the greatest number of bergs for the season. After June 6 no bergs of any size drifted south of the Bank. The total number of bergs drifting south of Newfoundland during 1926 was nearly normal but the seasonal distribution was not. (See p. 72.) Three bergs drifted much farther south than the others, crossing the westbound steamship lane route, known as track B. Due to the presence of this ice in such menacing positions the tracks were shifted to A, 60 miles farther south from June 5 to 30. As previously stated there were reports of only two bergs of any consequence in June around the Tail of the Bank, one on the 12th and the other on the 17th. The last two weeks of that month these waters were free of ice and under such conditions consequently it was considered safe to discontinue the patrol on June 30.

A considerable number of bergs, it should be added, were reported on the northern part of the Bank, from May on throughout the ice season.

The patrol was treated to an unusually long rough spell of weather persisting to the latter part of April before the backbone of winter was finally broken. This agrees quite closely with the seasonal change to the westward over the United States when winter conditions prevailed unusually late into the spring of 1926. Winter atmospheric circulation of the ice regions differs quite markedly from summer time conditions. The Grand Banks south of Newfoundland are located on the southern side of a cyclonic wind system caused by the normal winter distribution of atmospheric pressures. The barometric gradients are exceedingly steep, causing westerly gales to blow with great and constant intensity for several days at a time, though they are often interrupted by low centers of marked disturbance, moving along a northeasterly track to die offshore in the Atlantic. It can be imagined that under such severe handicaps as prevailed this year, March 25 to April 22, little work of any value could be carried on. By the same token it is considered unwise in any year to inaugurate the patrol work so long as winter conditions persist.

The scientific work carried on this season was under the supervision of Lieutenant Commander Smith, who returned to the patrol after spending a year abroad on two of the most important natural problems which have for some time confronted us, viz (*a*) information regarding the probable drift of ice after arriving at the Tail of the Grand Banks, and (*b*) advance information about the annual amount of ice to be expected south of Newfoundland. The former subject is discussed under the section devoted to oceanography; the latter is taken up under the heading "Weather."

A notable advance in this year's work was the employment of dynamic methods to determine and map the currents around the Grand Banks. A special bulletin, No. 14, describing the work for use on ice patrol, has recently been published by the Coast Guard. The final answer as to the degree of success attending it depends on its practical employment on future ice patrols. It would be very wise and advisable if officers of the Coast Guard detailed to patrol duty were required to acquaint themselves with these methods in order that several may possess this knowledge instead of only one officer, as is now the case. The international ice patrol will give its most efficient and economic service to shipping only when useful scientific methods are employed to support the practical work.

The patrol ships were equipped this year with practically the same outfits as they had on board in 1925, with the exception of new high-frequency radio sets, especially intended for use in communication with shore, and a second electric salinity set so that determinations might be made on board both ships instead of on one alone, as in previous seasons. The performance of the new radio sets for ship-to-shore communication, as stated in more detail under the section devoted to communications, page 14, well repaid the expense and effort expended in placing the apparatus on board.

About 465 hydrographical soundings by means of the sonic apparatus were made during the season at various positions both in the shallow waters over the Grand Bank and offshore, particularly to the southward of the Bank in the deeper portions of the Atlantic Basin. These are described under the section devoted to sonic sounding, page 49. The value of carrying on this work on future patrols is emphasized, and in this connection it is believed that both ice patrol vessels ought to be equipped with sonic depth apparatus instead of one, as is now the case; steps also ought to be taken to have at all times at least one trained operator on board.

About 450 steamships are known to have taken advantage of the services offered by the ice patrol in 1926. No doubt several other ships of which there is no mention also listened-in for the daily broadcasts. The following list is submitted in order that the reader may gain an idea of the service which is being given the ships of many nationalities. The masters of these vessels have been individually thanked, by letter, by the chairman of the interdepartmental board in charge of ice patrol.

Belgian	8	Danish	8	Greek	1	Argentian	1
British	171	Dutch	25	Italian	9	Spanish	5
Canadian	27	French	13	Japanese	1	Swedish	11
Chilean	1	German	14	Norwegian	20	United States	114

A summary of work performed, the dissemination of information, and other miscellaneous business handled by the Patrol for 1926 follows:

Washington official messages	470
Daily routine broadcasts	372
Special broadcasts (during fog)	42
Ice information to certain vessels, special	165
Special ice information requested	48
Position reports requested	1
Track information requested	4
Chronometer comparisons	1
Weather reports	102
Water temperature reports received	5,488
Ice reports received from:	
Steamships	414
Cape Race	172
Words handled by radio	252,299
Violation of steamship tracks reported	1
S O S not in jurisdiction of Patrol vessels	4

As in previous years, the cooperation received from passing ships was generous and indicative of a sincere appreciation of this service, which is being financially supported by international contribution. The commander of the ice patrol takes this opportunity to thank all those who assisted to make the past season's work successful.

TABLE OF ICE AND OF OTHER OBSTRUCTIONS, 1926

Date	No.	Vessel reporting	Position		Nature of ice or obstruction
			Latitude, north	Longitude, west	
			° ′	° ′	
Feb. 8	1	Cape Race (station)	48 11	49 13	Slush ice.
10	2	do	48 15	49 40	Field ice east of St. Johns.
10	3	do	47 25 to 47 08	49 50 to 51 05	Occasional patches field ice.
10	4	do	44 53	59 52	Field ice.
15	5	do	Bull Head to Canso.		Do.
16	6	do	100 miles NE. Cape Race.		Do.
17	7	do	Along the coast		Heavy ice field.
19	8	do	44 46 to 44 40	58 57 to 60 28	Do.
20	9	do	48 09 to 48 06	48 07 to 49 20	Do.
20	10	do	47 50	50 04	Slab ice and small bergs.
21	11	do	45 15	59 44	Field ice.
21	12	do	47 17	47 03	Several small bergs.
22	13	do	41 04	37 40	Derelict schooner Cecil jr.
Mar. 2	14	do	48 16 to 47 40	46 50 to 47 50	Small bergs and growlers.
2	15	do	45 07 to 45 05	57 13 to 57 42	Field ice.
6	16	do	48 24	46 22	Do.
15	17	do	47 50	49 38	Field ice and occasional bergs.
16	18	do	47 24	50 57	Field ice.
18	19	do	47 54 to 46 57	47 58 to 48 45	Heavy field ice and small bergs.
19	20	do	46 56	47 49	Field ice and growlers.
19	21	do	45 00 to 45 30	58 20 to 57 40	Field ice.
19	22	do	45 40 to 46 05	47 00 to 46 25	Field ice and large growlers.
20	23	do	46 20 to 45 40	46 40 to 48 30	Do.
20	24	do	45 38	46 23	Small bergs.
20	25	do	45 41	46 03	1 berg.
20	26	do	46 20 to 45 40	46 40 to 48 30	Field ice and growlers.
20	27	do	45 10	46 30	Large bergs.
20	28	do	45 15	46 45	Small berg.
20	29	do	45 16	47 29	Large berg.
20	30	do	45 17	47 46	Do.
20	31	do	45 09	48 35	Do.
21	32	do	44 55	46 23	Growlers.
21	33	do	44 50	48 30	Numerous growlers; field ice.
22	34	do	44 35	57 20	Field ice.
22	35	do	44 22	48 36	Field ice and growlers.
22	36	do	44 18	48 36	Small berg.
20	37	Hydrographic Office	45 17	46 30	4 large bergs.
20	38	do	45 30	48 10	3 bergs.
21	39	do	45 15	48 10	Large ice field.
23	40	Naturia	48 10	48 00	Large ice field; growlers.
23	41	Cape Race (station)	48 20	49 15	Field ice.
23	42	do	43 47 to 43 43	48 28 to 48 41	Field ice and growlers.
25	43	do	43 45	48 07	Do.
25	44	do	48 45 to 48 00	49 20 to 48 00	Field ice.
25	45	do	45 50	47 20	Do.

Table of ice and of other obstructions, 1926—Continued

Date	No.	Vessel reporting	Position: Latitude, north	Position: Longitude, west	Nature of ice or obstruction
			° ′	° ′	
Mar. 26	46	Cape Race (station)	42 51	58 04	Spar attached to wreckage.
27	47	do	47 00	48 00	Large bergs.
27	48	do	44 20	49 10	Large growlers.
27	49	Baltic	49 10 to 47 31	49 23 to 46 34	Large ice field.
29	50	Noresfjord	47 33	46 23	Field ice and growlers.
29	51	do	46 40	47 24	Large berg.
29	52	Dakarian	40 32	47 36	Derelict schooner Max Horton on fire.
31	52*a*	Laleham	39 05	56 37	Foundered steamer Laleham.
Apr. 1	53	Cape Race	44 42	57 15	Heavy ice field.
2	54	Helig Olav	45 11	45 00	Ice berg.
2	55	Cape Race (station)	47 47	52 05	Ice field.
2	56	do	47 20	52 09	Do.
3	57	London Exchange	46 15 to 45 00	47 35 to 48 50	Field ice and growlers.
3	58	Cape Race (station)	42 43	55 40	Spar attached to wreckage.
4	59	Ice patrol	43 59	48 55	Field ice, southern extremity.
5	60	do	43 33	49 12	Same as 59; drifting 190°, 1 knot.
5	61	do	42 23	49 12	Same as 59; drifting 180°, 1 knot.
6	62	Tampa (steamer)	45 32 to 46 32	48 20 to 47 36	Field ice and growlers.
8	63	Sulina	44 00	48 10	3 small bergs.
9	64	Ice patrol	44 10	47 54	Same as 63; drifting 49°, 0.7 knot.
10	65	Manchester Corporation	44 55	46 52	1 iceberg.
10	66	Carlsholm	46 55	47 25	Field ice.
11	67	do	46 45	48 00	Western side of ice field, same as 66.
12	68	Alaunia	44 43	60 32	Field ice (St. Lawrence).
13	69	do	44 44	60 26	Do.
13	70	City of Kimberly	44 44	59 10	Do.
14	71	Alaunia	44 04	56 47	Do.
14	72	Cameronia	46 58	46 30	Do.
14	73	do	47 01	45 16	4 bergs and growlers.
14	74	Bellflower	45 05	46 34	1 berg, 2 growlers.
16	75	London Mariner	44 32	45 16	Small berg.
16	76	Transylvania	46 25 to 45 58	47 00 to 47 45	Field ice and growlers.
16	77	Regina	46 34	47 54	1 berg, 2 growlers.
16	78	do	46 27	47 47	1 berg.
16	79	Transylvania	45 42	48 15	1 large berg.
16	80	do	45 57	47 45	2 growlers.
16	81	do	46 05	47 22	1 growler.
16	82	do	45 48	47 42	Low lying ice field.
17	83	Bergensfjord	45 40	45 25	3 growlers.
17	84	do	45 39	45 28	1 growler.
17	85	Lorenz Hansen	39 39	55 26	Deck load of spars.
17	86	Cedarhurst	39 46	57 45	Sea covered with wreckage.
20	87	Idefjord	46 55	45 45	2 small bergs same as 73.
20	88	Terra Nova	47 10	51 00	Western edge field ice.
21	89	Athenia	45 52	47 57	Large berg, same as 77.
21	90	Aurania	47 40	46 15	1 berg.
21	91	do	47 16 to 47 14	47 10 to 47 20	Field ice.
21	92	Montnairn	46 46	45 39	Small berg, same as 73.
21	93	Ansonia	45 53	45 12	Do.
21	94	Aurania	47 00	48 00	1 berg.
22	95	Doric	47 40	46 21	Low lying berg.
22	96	Station Belle Isle	------	------	84 bergs in sight; field ice.
22	97	Caronia	47 35	46 11	Small berg, same as 95.
22	98	do	47 28	46 28	Small berg.
22	99	do	47 27	46 35	Do.
22	100	do	47 14	46 47	Small berg and growlers.
22	101	do	47 09	47 00	20 bergs in heavy pack ice.
22	102	do	46 52	46 48	Field ice, same as 88.
22	103	Montrose	47 38	44 40	1 growler.
22	104	Caronia	46 10	48 11	1 small berg.
23	105	Bothwell	47 02	45 47	Large berg.
23	106	do	46 27	47 06	Southern end field ice; seven bergs.
23	107	Twickenham	48 28	48 29	Heavy field ice.
24	108	Cairntorr	48 25	47 10	Do.
24	109	Geraldine Mary	47 13	47 42	Field ice.
24	110	do	47 13	50 52	Berg.

Table of ice and of other obstructions, 1926—Continued

Date	No.	Vessel reporting	Position: Latitude, north	Position: Longitude, west	Nature of ice or obstruction
			° ′	° ′	
Apr. 24	111	Geraldine Mary	46 58	46 48	Field ice.
24	112	Wirral	47 00	44 40	2 bergs.
24	113	Blackheath	48 16	47 10	Scattered field ice.
24	114	Arabic	47 36	43 49	Small berg, same as 112.
24	115	do	47 05	44 41	Do.
24	116	Cairntorr	48 25 to 47 49	46 30 to 46 40	Slob ice.
24	117	Maidenhead	46 11	48 48	Large berg.
26	118	Cairntorr	46 45	47 30	Heavy field ice; numerous bergs.
26	119	do	47 49 to 47 05	46 40 to 47 25	Open field ice; several bergs.
26	120	do	47 05 to 46 49	47 25 to 47 14	Heavy field ice; many bergs.
26	121	do	46 32	47 45	Western edge of field ice.
27	122	Unknown ship	47 08	46 18	Large berg, same as 101.
27	123	do	47 07	46 34	Growlers, same as 101.
27	124	do	47 06	46 32	Do.
27	125	do	47 10 to 45 56	46 44 to 47 35	Heavy field ice; numerous bergs.
27	126	do	45 57	47 37	Large berg.
27	127	Minnedosa	47 10	46 03	5 growlers, same as 101.
27	128	do	47 12	46 19	Berg, same as 122.
27	129	do	47 03	46 30	Large ice field with many bergs, same as 101.
28	130	Transylvania	44 48	48 41	Small berg and growlers.
28	131	Minnedosa	45 48 to 45 33	47 00 to 47 24	*Patches of slob ice.*
28	132	Bawtry	45 50	47 22	Berg; patches field ice, same as 131.
29	133	Montcalm	47 34 to 47 04	46 39	Patches of field ice.
29	134	do	47 00	46 52	Berg, same as 101.
29	135	do	46 50	47 06	3 bergs, same as 101.
29	136	Drottingholm	44 47	48 39	Small berg and growler, same as 130.
29	137	do	44 32	48 48	Large berg.
29	138	Zeeland	45 03	48 05	Do.
29	139	do	44 35	48 25	Do.
29	140	do	44 52	48 32	Small berg, same as 136.
29	141	do	44 18	48 46	Large berg, several growlers.
29	142	do	44 32	48 58	Large berg, several growlers, same as 137.
29	143	Valemore	45 29 to 45 29	47 45 to 48 02	Southern end of ice field.
29	144	do	45 29	48 21	Low lying ice berg.
29	145	Canadian Commander	45 28	48 03	An ice field.
29	146	Modig	48 33 to 48 58	45 35 to 49 30	Patches of field ice.
May 1	147	Frode	45 25	48 31	Berg.
2	148	Roussillon	44 10	48 30	Do.
2	149	Suderoy	46 09	46 24	Field ice.
3	150	Brandon	45 20	46 03	Skirting southern end ice field.
3	151	Lord Downshire	47 03	47 15	2 bergs.
3	152	Montairn	44 50	48 13	3 growlers.
4	153	Athenic	45 47	46 31	1 berg.
5	154	Doric	46 22	47 53	Field ice.
5	155	Thuban	45 50	48 00	Much field ice and small bergs.
5	156	Welshman	45 47	46 59	2 growlers.
5	157	Empress of France	46 38	47 25	Scattered field ice, same as 154.
6	158	Regina	48 07	43 34	Western edge field ice.
7	159	Winterswijk	45 50	46 20	Large growler.
7	160	Athenia	45 51 to 44 35	48 50 to 48 45	3 bergs, several growlers.
8	161	Winterswijk	44 35	48 45	Field ice.
8	162	Ansonia	44 48	48 46	2 bergs, same as 160.
8	163	do	44 47	48 45	Western ice.
8	164	Procyon	47 20 to 47 23	46 29 to 47 30	Many bergs and growlers.

Table of ice and of other obstructions, 1926—Continued

Date	No.	Vessel reporting	Position: Latitude, north	Position: Longitude, west	Nature of ice or obstruction
			° ′	° ′	
May 8	165	Ansonia	45 02	49 18	Growlers.
8	166	Letitia	44 38	48 51	Berg.
8	167	do	44 54	48 46	Do.
8	168	do	44 55	48 38	Do.
8	169	Montrose	47 00	47 25	Heavy ice field.
8	170	Ansonia	44 55	46 00	Berg and 2 growlers.
9	171	Letitia	44 51	46 51	Berg.
9	172	Tyrifjord	45 07 to 45 00	47 51 to 48 36	3 bergs, same as 166 to 168.
9	173	Minnedosa	45 45	49 51	Small berg and growler.
9	174	do	45 47	49 49	1 berg.
10	175	Berk	44 27	46 31	2 bergs and ice field.
10	176	do	44 21	46 44	Berg.
11	177	Sheafbrook	46 40	56 10	Derelict bottom up.
12	178	Canada	45 31	49 49	Small berg, same as 173.
12	179	Melita	46 12	48 40	Large berg.
12	180	California	44 15	48 30	Do.
12	181	Montroyal	45 58	48 28	Berg.
12	182	Cairndhu	45 37	48 00	1 berg, 13 growlers.
12	183	California	44 15	48 56	Large growler.
12	184	Cairndhu	45 38	49 00	Berg.
12	185	Lenfield	45 03	49 09	Do.
12	186	Cairndhu	45 38	49 20	Do.
12	187	do	45 38	49 37	2 bergs.
12	188	Marbarn	44 08	49 05	Large berg.
12	189	Alaunia	44 00	49 12	Low-lying berg.
13	190	Metagama	45 44	47 29	Large berg.
13	191	do	45 30	48 19	2 growlers.
13	192	Ice Patrol	43 01	49 33	Berg.
13	193	Cameronia	46 34	48 34	Do.
13	194	do	46 38	48 41	2 growlers.
13	195	do	46 21	48 52	Berg.
13	196	do	46 24	48 58	Do.
13	197	do	46 39	49 00	Do.
13	198	do	46 18	49 07	Do.
13	199	Searstad	47 50 to 47 50	48 20 to 47 30	Numerous bergs.
13	200	Marburn	46 42 to 46 34	46 55 to 47 06	Numerous bergs and growlers.
13	201	Delaware	39 32	50 47	Spar attached to wreckage.
13	202	Metagama	45 35	50 26	Berg.
13	203	Oxonion	46 00 to 46 00	50 02 to 49 00	Small bergs and growlers.
13	204	Ascania	47 17	47 00	Berg.
13	205	Cornish City	43 21	49 13	Low-lying berg.
13	206	do	43 21	49 02	Growlers.
13	207	Boswell	46 05	49 50	Berg.
13	208	do	45 50	49 50	Low-lying berg, same as 203.
13	209	Cameronia	46 12	49 24	Berg, same as 207.
13	210	do	46 05	49 22	Berg, duplicated.
13	211	do	45 59	49 16	Berg.
13	212	do	45 59	49 20	Berg, duplicated.
13	213	do	46 06	49 23	Do.
13	214	do	46 18	49 44	Do.
13	215	do	46 06	49 31	Do.
13	216	do	46 01	49 40	Do.
13	217	do	45 32	49 46	1 berg and growlers.
13	218	Mexico	43 30	49 10	Berg.
13	219	do	43 24	48 50	Do.
14	220	Ice patrol	43 05	49 15	Low-lying berg, same as 205.
14	221	do	43 10	49 26	Small berg.
14	222	do	43 23	49 29	Low berg.
14	223	Megantic	46 30	47 50	Berg.
14	224	do	46 47	47 40	Do.
14	225	do	46 32	48 18	Do.
14	226	Penland	45 46	49 31	Growlers.
14	227	Ascania	46 53	48 15	Berg.
14	228	Andersen	40 38	54 10	Spar attached to wreckage.
14	229	Ice patrol	44 00 to 43 35	49 10 to 49 19	17 bergs along edge of Bank.
14	230	Jean D'Arc	43 50 to 44 15	49 22 to 49 15	Ice field and several growlers.

Table of ice and of other obstructions, 1926—Continued

Date	No.	Vessel reporting	Position: Latitude, north ° ′	Position: Longitude, west ° ′	Nature of ice or obstruction
May 14	231	Brattingsborg	46 25	47 00	Field ice and small bergs.
15	232	Ice patrol	42 44	49 59	Same as 229.
15	233	Sunoco	46 48 to 46 00	46 36 to 49 50	Bergs continuously and growlers.
15	234	Brattingsborg	46 15	48 00	Numerous bergs, same as 233.
15	235	Ice patrol	42 47	49 50	Same as 232.
16	236	do	43 02	49 52	Same as 192, grounded berg on Tail.
16	237	Kapristan	45 02	50 00	Several small bergs and growlers.
16	238	Topdalsfjord	48 16	49 40	2 bergs.
16	239	do	48 07	46 56	1 berg.
16	240	do	48 03	50 08	2 bergs.
16	241	do	47 46	50 40	1 berg.
16	242	Kinghorn	49 02	49 30	3 bergs.
16	243	do	49 15	48 54	2 bergs.
16	244	Port Sydney	47 00	45 40	Slot ice.
16	245	Gracia	47 23	47 14	4 bergs.
17	246	do	46 07	49 44	Several bergs, same as 101.
17	247	Montclare	45 15 to 45 10	49 42 to 48 56	12 bergs.
19	248	Antonia	45 16	49 54	3 bergs, same as 247.
19	249	Lord Kelvin	47 14	46 35	Berg.
19	250	do	47 16	46 37	Do.
19	251	do	47 05	46 45	Large berg.
20	252	do	47 00	47 11	Do.
20	253	do	46 53	47 20	Berg.
20	254	Lord Kelvin	46 19	48 57	Large berg.
20	255	Empress of Scotland	47 48	48 09	2 bergs, 1 growler.
20	256	do	47 45	48 26	2 large bergs.
20	257	Welshman	48 22	46 16	Berg.
20	258	Tiger	43 04 to 43 02	49 20 to 49 20	10 bergs, several growlers.
20	259	do	43 03	49 41	Berg.
20	260	do	42 59	49 53	Do.
20	261	do	42 58	50 02	Do.
20	262	Moveria	46 06	48 45	Do.
20	263	do	46 09	48 56	Do.
20	264	do	46 14	48 25	Do.
20	265	do	46 36	47 40	Do.
20	266	Aalsum	44 00 to 44 00	49 02 to 48 26	3 bergs, several growlers.
21	267	Ice patrol	42 43	50 10	Berg, same as 258.
21	268	do	42 45	50 08	Do.
21	269	do	42 54	50 09	Do.
21	270	do	42 30	50 10	2 growlers, same as 258.
21	271	Empress of Scotland	47 34	49 15	Berg.
21	272	do	47 33	49 32	Do.
21	273	Arlington Court	47 48	48 13	2 bergs.
21	274	Tenbergen	46 29	46 22	Small berg.
21	275	do	46 26	46 45	Do.
21	276	do	46 17	46 50	Do.
21	277	do	46 22	46 50	Large berg.
21	278	do	46 17	47 35	Small berg.
21	279	Brecon	46 27	48 22	Berg.
21	280	do	46 23	48 26	Do.
21	281	do	46 11	48 51	Do.
22	282	Venus	46 27	50 13	Do.
22	283	do	47 32	49 56	Do.
22	284	Estonia	48 45	48 55	2 growlers.
22	285	do	48 46	47 57	Do.
22	286	Letitia	49 33	45 05	Berg.
22	287	do	49 24	45 05	Do.
22	288	do	49 23	45 26	Do.
22	289	do	49 22	45 25	Do.
22	290	do	49 25	43 35	Do.
22	291	do	49 16	45 36	Do.
22	292	Hastings County	48 45	48 47	Do.
22	293	do	49 08	47 47	Do.
22	294	Letitia	48 30	47 55	Do.
22	295	do	48 25	48 08	Do.
22	296	do	48 18	48 14	Do.

Table of ice and of other obstructions, 1926—Continued

Date	No.	Vessel reporting	Position: Latitude, north	Position: Longitude, west	Nature of ice or obstruction
			° ′	° ′	
May 22	297	Ice patrol	Around	Tail	26 bergs, scattered around Tail.
22	298	Letitia	49 33	45 05	Berg.
22	299	do	49 24	45 26	Do.
22	300	do	49 22	48 25	Do.
22	301	do	49 16	45 36	Do.
22	302	do	49 04	46 05	Do.
22	303	Manchester County	48 50	47 00	Do.
23	304	Metagama	47 22	50 01	Do.
23	305	do	47 29	49 59	Do.
24	306	Thyra	44 02	48 42	4 bergs.
24	307	Metagama	47 46	49 07	Berg.
24	308	Montrose	48 33	49 27	Do.
26	309	Cameronia	48 04	49 20	Berg, same as 297.
26	310	Clearpool	42 24	50 20	Growlers, same as 297.
26	311	do	42 24	50 20	Berg, same as 297.
26	312	Wanjasdga	42 42	50 01	Do.
26	313	do	42 51	50 00	Do.
26	314	Cameronia	48 55	47 23	Berg.
27	315	Ice patrol	42 15	50 32	A group of 5 bergs, same as 297.
27	316	do	42 34	51 05	Berg, same as report No. 297.
27	317	do	42 37	51 09	Do.
27	318	American Merchant	43 54	44 45	Berg.
27	319	Zeeland	48 04	47 27	Do.
27	320	California	48 14	44 44	Do.
27	321	do	47 34	46 21	Do.
27	322	do	47 25	47 00	Do.
27	323	Ansonia	48 38	44 50	Do.
27	324	do	48 25	46 25	Do.
27	325	do	48 28	46 20	Do.
28	326	Ice patrol	42 12	50 10	Group of 5 bergs, same as 315.
28	327	Chicago	41 51	48 33	Berg, probably same as 297.
28	328	Hamburg	41 48	48 26	Berg, same as 327.
28	329	Seattle Spirit	41 50	48 23	Do.
28	330	Inverurie	40 54	47 00	Small vessel bottom up.
29	331	Ice patrol	41 23	48 23	Berg, same as 327.
29	332	Western Plains	42 04	49 38	Berg, same as 315.
29	333	do	42 05	49 48	2 bergs, same as 315.
29	334	Unknown ship	45 00	47 50	4 bergs, 7 growlers.
29	335	Oscar II	42 28	50 19	Same as 297.
29	336	do	42 25	50 30	Do.
29	337	do	42 40	50 33	Do.
29	338	do	42 37	51 35	Same as 316.
29	339	do	42 39	51 36	Same as 317.
30	340	Ice patrol	40 56	47 56	Same as 327.
30	341	Empress of Scotland	48 15	45 14	Small berg.
30	342	Virginia	43 22	43 02	Berg, same as 318.
30	343	Cape Race (station)	48 23	50 38	3 bergs.
30	344	do	48 17	51 06	Berg.
30	345	do	48 19	51 50	Large berg and growlers.
30	346	do	48 22	46 57	Berg.
30	347	do	48 30	51 02	2 growlers.
30	348	do	48 27	51 06	Berg.
30	349	do	47 30	50 58	Large berg.
30	350	do	47 34	51 04	Berg.
30	351	do	48 03	50 08	5 bergs.
30	352	do	48 13	51 53	Berg, same as 345.
30	353	do	48 07	52 24	Berg.
30	354	do	48 09	52 15	Do.
30	355	do	48 20	51 23	Do.
30	356	do	47 24	51 28	Do.
31	357	Ice patrol	40 44	47 39	Growler, same as 327 (melted).
31	358	Quercus	44 24	46 52	2 bergs.
31	359	Letitia	47 39	50 33	Berg.
31	360	do	47 45	50 32	Do.
31	361	do	47 42	50 21	Berg and growlers.
31	362	do	47 53	50 04	Berg.
31	363	do	47 54	49 59	Do.
31	364	do	47 49	49 48	Do.
31	365	do	47 22	51 26	Growler.
31	366	do	47 38	51 07	Berg.
31	367	do	47 31	50 54	Do.
31	368	do	47 38	50 37	Do.
June 1	369	Stadisdyk	41 35	49 41	Berg (position probably northward).
1	370	do	41 36	50 12	Do.
1	371	George Washington	41 26	48 34	Small berg.
1	372	Winona County	41 53	50 15	Berg.
1	373	do	41 54	50 02	Do.

Table of ice and of other obstructions, 1926—Continued

Date	No.	Vessel reporting	Position: Latitude, north ° ′	Position: Longitude, west ° ′	Nature of ice or obstruction
June 1	374	America	1 53	50 01	2 small bergs.
1	375	Veendam	42 09	48 50	Berg and 2 growlers.
1	376	Port Sydney	47 03	50 33	Berg.
1	377	do	47 00	50 24	Do.
1	378	do	47 07	50 09	Do.
1	379	do	47 01	49 52	Do.
1	380	do	47 19	49 46	Do.
1	381	Berk	47 19	51 28	Do.
1	382	Hilversum	47 34	50 19	Do.
1	383	do	47 00	50 41	Do.
1	384	do	47 16	49 54	Do.
1	385	Ice patrol	41 27	48 25	Berg, same as 371.
1	386	Innerton	42 08	49 15	Small berg.
1	387	Veendam	42 10	49 24	Berg.
1	388	Transylvania	47 18	51 30	Do.
1	389	do	47 27	50 59	Do.
1	390	do	47 07	50 36	Do.
1	391	do	47 34	50 54	Do.
1	392	do	47 33	50 40	Do.
1	393	do	47 16	50 16	Do.
1	394	do	47 37	50 52	Do.
1	395	do	47 41	50 24	Do.
1	396	do	47 54	50 06	Do.
1	397	do	47 50	49 59	Do.
1	398	do	47 50	49 48	Do.
2	399	Ice patrol	41 18	48 08	Berg, same as 371.
2	400	Bellflower	41 31	48 38	Large berg.
2	401	Drottingholm	42 00	49 02	Do.
2	402	do	42 02	49 06	Do.
2	403	Tiger	47 16 to 47 41	51 22 to 51 36	6 bergs.
2	404	Bolingbroke	47 10	50 10	Berg.
2	405	do	47 04	50 19	Do.
2	406	do	47 07	50 50	Do.
3	407	Ice patrol	41 00	48 38	Berg, same as 371.
3	408	do	41 15	48 38	Berg, same as 402.
3	409	Springbank	42 29	51 14	Berg, same as 337.
3	410	do	42 34	51 11	Berg, same as 338.
3	411	do	42 30	51 12	Small berg, same as 339.
3	412	Bronte	41 51	48 34	Berg, same as 403.
3	413	Lehigh	42 00	48 50	Small berg.
4	414	Ice patrol	41 06	48 27	Berg, same as 402.
4	415	Cape Race (station)	47 30	49 26	Berg.
4	416	do	47 18	49 59	Do.
4	417	do	47 14	50 15	Do.
4	418	do	47 12	47 47	Do.
4	419	Westphalia	42 38	51 09	Do.
4	420	do	42 47	51 01	Do.
4	421	do	42 44	51 12	Do.
4	422	American Shipper	41 57	49 28	Do.
5	423	Ice patrol	40 57	48 38	Berg and growlers, same as 402.
5	424	Unknown ship	46 50	51 10	Very large berg.
5	425	Cape Race (station)	47 32	50 12	Berg.
5	426	do	47 50	50 18	Do.
5	427	do	47 12	50 17	Do.
5	428	do	47 18	49 53	Do.
5	429	do	47 24	49 50	Do.
5	430	do	47 26	49 37	Do.
5	431	do	47 15	49 35	Do.
5	432	do	47 25	49 25	Do.
5	433	John W. Mackay	42 58	51 25	Do.
5	434	do	42 49	51 23	Do.
6	435	Ice patrol	40 57	48 38	Berg, same as 402.
6	436	Roussillion	42 55	49 11	Berg.
6	437	do	42 59	49 56	Do.
6	438	Berk	43 06	52 13	Do.
6	439	do	42 55	51 19	Do.
6	440	do	42 58	51 25	Do.
6	441	do	42 46	47 47	Do.
7	442	Aurania	47 35	49 35	Berg and growler.
7	443	Cape Race (station)	47 04	50 49	Berg.
7	444	do	47 58	49 07	Do.
7	445	do	47 35	49 55	Do.
7	446	do	47 31	49 45	Do.
7	447	do	47 58	48 17	Do.
7	448	do	47 59	48 14	Do.

Table of ice and of other obstructions, 1926—Continued

Date		No.	Vessel reporting	Position				Nature of ice or obstruction
				Latitude, north		Longitude, west		
				°	′	°	′	
June	7	449	Cape Race (station)	47	48	50	27	Berg.
	7	450	do	48	42	49	02	Do.
	7	451	do	48	34	49	16	Do.
	7	452	do	48	30	49	20	Do.
	7	453	do	48	28	49	20	Do.
	7	454	do	47	42	51	09	Do.
	7	455	Aurania	47	45	49	49	Do.
	7	456	do	47	32	49	37	Do.
	7	457	do	47	35	49	35	Do.
	7	458	do	48	03	49	07	Do.
	7	459	do	48	18	48	51	Do.
	7	460	do	48	05	48	18	Berg 160 feet high.
	7	461	do	48	12	48	21	Berg.
	8	462	Calumet	47	35	49	31	Berg and growlers.
	8	463	Cape Race (station)	47 50 to 48 42		48 18 to 51 15		Many bergs and pieces of ice.
	9	464	Montroyal	47	28	49	51	Low-lying berg.
	9	465	Cleveland	40	17	56	07	Red spherical buoy.
	9	466	Deuteldijk	34	34	50	46	Red and black bell buoy.
	11	467	Antonia	47	41	48	48	Large berg, several growlers
	11	468	do	47	34	48	48	Low-lying berg.
	11	469	Cape Race (station)	47	02	57	55	Wreckage of schooner.
	11	470	do	47	27	50	54	Berg.
	11	471	do	47	45	50	29	Do.
	11	472	do	South Cape Francis				5 bergs.
	11	473	do	47	37	49	28	Berg.
	11	474	do	47	46	48	37	Do.
	11	475	do	47	33	49	24	Do.
	11	476	do	47	33	49	28	Do.
	11	477	do	47	32	49	33	Do.
	12	478	Livenza	42	49	49	18	Do.
	12	479	do	42	50	49	08	Do.
	12	480	Cape Race (station)	47	41	47	31	Large berg.
	12	481	do	47	35	48	52	Berg.
	12	482	do	47	57	50	03	Do.
	12	483	do	47	25	51	40	Do.
	13	484	Drammensfjord	46	06	48	38	Do.
	13	485	Nesstad	43	08	50	10	Do.
	14	486	Cape Race (station)	47	14	48	37	Berg and growlers.
	14	487	do	46	45	52	50	Berg.
	14	488	do	45	19	48	00	Large berg.
	14	489	Estonia	47	45	51	07	Do.
	14	490	do	47	53	51	15	Do.
	14	491	Delaware	47	28	51	23	Small berg.
	15	492	Cape Race (station)	47	30	52	30	Berg.
	15	493	do	47	22	50	34	Do.
	15	494	Alaunia	47	09	50	00	Do.
	15	495	Unknown ship	47	21	50	16	Do.
	15	496	do	47	47	49	13	Do.
	15	497	do	48	00	48	44	Do.
	15	498	Caledonia	48	07	48	35	Do.
	15	499	Doric	48	14	49	06	Do.
	15	500	do	48	13	49	16	Do.
	15	501	do	49	12	49	21	Do.
	15	502	Alaunia	47	50	47	13	Do.
	15	503	Nova Scotia	47	51	52	15	Do.
	15	504	do	47	51	52	04	Do.
	15	505	do	48	10	51	54	Do.
	15	506	do	48	17	51	17	Do.
	15	507	do	48	25	50	57	Do.
	15	508	Canadian Transporter	47	32	50	17	Do.
	15	509	Cape Race (station)	46	45	52	53	Do.
	15	510	do	47	23	51	21	Do.
	15	511	do	47	47	50	16	Do.
	15	512	do	48	14	49	09	Do.
	15	513	do	48	20	48	50	Do.
	15	514	do	47	09	50	00	Berg, same as 497
	15	515	do	47	23	50	04	Berg.
	15	516	do	48	37	51	31	Do.
	15	517	do	47	35	51	40	Do.
	15	518	do	47	30	48	25	Do.
	15	519	do	47	21	50	00	Do.
	15	520	do	46	55	52	35	Do.
	15	521	do	47	00	52	22	Do.
	15	522	do	47	14	51	42	Do.

Table of ice and of other obstructions, 1926—Continued

Date	No.	Vessel reporting	Position				Nature of ice or obstruction
			Latitude, north		Longitude, west		
			°	′	°	′	
June 15	523	Cape Race (station)	47	44	50	55	Berg.
15	524	do	47	30	50	37	Do.
15	526	do	47	50	47	13	Do.
16	527	do	47	51	52	15	Do.
16	528	do	48	17	51	01	Do.
16	529	do	48	25	50	57	Do.
16	530	do	47	35	51	11	Do.
16	531	do	47	27	51	07	Do.
16	532	do	47	13	51	30	Do.
16	533	do	47	56	49	50	Do.
17	534	Ascania	48	30	45	55	Do.
17	535	Montrose	48	07	49	38	Growlers.
17	536	do	47	52	50	04	Berg.
17	537	do	47	55	49	26	Do.
17	538	Sydland	44	40	45	35	Do.
17	539	King Gruffydd	45	32	48	04	Small berg.
17	540	Transylvania	47	17	50	40	Large berg.
17	541	Greldon	43	45	51	11	Small berg.
17	542	Transylvania	46	36	52	56	Berg.
17	543	do	46	24	53	10	Do.
17	544	Letitia	47	17	50	14	Do.
17	545	do	48	11	49	22	Do.
17	546	Montrose	47	06	51	27	Small berg.
18	547	Valemore	47	29	48	04	Berg and growler.
18	548	do	46	50	50	15	Berg.
18	549	do	46	48	50	40	Do.
19	550	United States	42	25	49	07	Small berg and growler.
20	551	Cape Race (station)	46	52	48	05	Berg.
20	552	Denham	44	50	45	55	Small berg.
20	553	do	44	48	46	30	Large berg.
20	554	Metagama	46	15	53	06	Small berg.
21	555	Montroyal	47	30	49	59	Large berg.
21	556	do	46	28	51	45	Berg.
21	557	do	46	14	53	05	Growler.
21	558	Norefjord	46	35	54	00	Berg.
21	559	Unknown ship	44	76	45	40	Do.
21	560	Trelissick	46	20	53	10	Growler.
21	561	Cape Race (station)	47	50	48	33	Berg.
21	562	do	47	35	49	50	Do.
21	563	do	46	56	51	36	Do.
21	564	do	47	03	50	54	Do
21	565	Bleddyne	46	02	47	02	Do.
21	566	Cape Race (station)	47	53	51	00	Do.
21	567	do	47	40	50	54	Do.
21	568	do	47	05	50	37	Do.
22	569	do	47	12	51	24	Do.
22	570	do	46	59	51	32	Do.
22	571	do	47	20	51	30	Do.
22	572	do	47	20	50	50	Do.
22	573	do	46	02	47	20	Do.
22	574	do	47	26	51	40	Do.
22	575	do	46	58	51	21	Do.
22	576	do	47	07	50	47	Do.
22	577	do	47	28	49	51	Do.
22	578	do	47	20	49	44	Do.
23	579	Montcalm	47	48	50	40	Do.
23	580	do	47	52	50	48	Do.
23	581	Antonia	46	24	52	28	Do.
23	582	do	46	57	51	55	Do.
23	583	do	46	58	51	22	Do.
23	584	do	47	37	49	56	Do.
23	585	do	46	30	52	45	Do.
23	586	do	47	07	50	55	Do.
23	587	do	47	34	48	43	Do.
23	588	Ulmus	42	26	45	28	Growler.
23	589	Cape Race (station)	47	48	50	40	Berg.
23	590	do	47	52	50	48	Do.
23	591	do	48	43	50	30	Do.
23	592	do	48	56	50	00	2 large bergs.
24	593	do	47	12	50	50	Berg.
24	594	do	48	39	49	58	Do.
24	595	do	47	39	50	57	Do.
24	596	do	46	48	52	36	Do.
24	597	do	48	50	50	10	Do.
24	598	do	49	07	49	30	Do.
24	599	do	46	45	52	45	Do.

Table of ice and of other obstructions, 1926—Continued

Date	No.	Vessel reporting	Position: Latitude, north °	′	Longitude, west °	′	Nature of ice or obstruction
June 24	600	Cape Race (station)	47	24	51	30	Berg.
24	601	Zeeland	47	31	49	40	Do.
24	602	do	47	11	50	46	Do.
25	603	Cape Race (station)	47	30	51	24	2 bergs.
25	604	do	48	31	51	59	Berg.
25	605	do	48	40	50	46	Do.
25	606	do	48	27	51	28	Do.
25	607	do	48	24	51	32	Do.
25	608	do	48	31	51	08	Do.
25	609	do	46	49	52	37	Do.
25	610	do	47	15	47	25	Do.
25	611	do	47	02	47	40	Do.
26	612	do	47	39	49	35	Do.
27	613	Beemsterdijk	47	10	49	38	Small berg.
27	614	Cape Race (station)	47	39	49	35	Berg.
27	615	do	48	09	44	44	Do.
27	616	do	47	30	50	39	Do.
27	617	do	47	53	49	47	Do.
27	618	do	46	49	52	01	Do.
27	619	do	47	10	49	38	Do.
27	620	do	48	05	49	05	Do.
28	621	Montrose	48	06	48	53	Do.
28	622	Cape Race (station)	47	40	51	19	Do.
28	623	do	46	52	52	02	Do.
28	724	do	47	50	49	55	Do.
28	625	do	47	39	49	52	Do.
28	626	do	48	18	50	01	Do.
28	627	do	48	16	48	49	Small patch of field ice.
28	628	do	47	50	49	55	Berg.
28	629	do	47	48	49	55	Do.
28	630	do	47	26	50	37	Do.
28	631	do	45	56	48	05	Do.
28	632	do	46	07	48	08	Do.
29	633	do	47	45	50	12	Growlers.
30	634	do	47	57	49	26	Berg.
30	635	do	48	19	52	17	Numerous small bergs
30	636	do	48	52	51	48	Berg.
30	637	do	49	04	50	49	2 large bergs.
30	638	do	47	50	49	20	Berg.
30	639	Ice patrol	41	50	51	45	Fisherman's buoy with cage; destroyed.

WEATHER—A BRIEF REVIEW OF THE 1926 ICE SEASON

EDWARD H. SMITH

As we sit down to write a worth-while, instructive report on the subject of weather, as it concerned the ice patrol of 1926, and in a sense as it probably concerns future patrols, we believe it most important to survey first only the principal features which were responsible in characterizing the 1926 season as a whole. Under this category comes foremost the steepness of the barometric gradients and the consequent great intensity of the winds that blew so constantly from the day we left Boston, March 25, until well along in April. It is impossible, of course, to place one's finger upon any definite date when a meteorological phenomenon such as we call "wintertime" conditions change to "summertime" conditions. This spring on the Grand Banks, however, we are convinced, that wintertime conditions prevailed longer than usual, and it was not until the latter part of April that we began to notice a slackening in the wind force, a dropping off in the frequency of storms, and a lessening in the tendency of great anticyclones to build up and spread eastward from the North American Continent. It also can be stated with considerable assurance that the atmospheric envelope was in a violent state of agitation from March 29 to April 20. During this period of 22 days the wind blew with gale force on 12 days, and there were only 2 days on which it did not attain a fresh to a strong breeze on the Beaufort scale. Before passing on from the remarks on wintertime meteorological conditions we should like to familiarize everyone with the general scheme of the air streams under which the ice regions come.

THE TWO MAJOR WEATHER TYPES WHICH PREVAIL IN THE ICE REGIONS

The ice season extending as it does from March to July bridges two main types of weather which standing at either end of the gamut we have termed wintertime and summertime conditions. This all important seasonal effect is of course superimposed upon the fundamental planetary system of circulation and is directly due to the thermal seesaw which is continually in process between land and water masses. In the North Atlantic (and controlling the weather of the ice regions), we have three great centers of action, triangularly located and with the relative condition of each determining the consequent behavior of the air: (*a*) the Icelandic minimum; (*b*) the

Azorean high; and (*c*) the continental effect of bordering land areas. Glancing at the normal isobaric map of the North Atlantic for the colder months of the year, the station normals of which are based upon average barometric records compiled over a long series of years, our eye is immediately caught by a huge elliptical-shaped depression near Iceland. And then we notice that in effect this depression is emphasized by the opposing anticyclonic conditions which prevail over the bordering land masses of the Atlantic basin. The geographical position of the Grand Banks in the western North Atlantic on the southwestern side of this mammoth cyclonic wind system, it is plain to see, subjects the iceberg regions south of Newfoundland to an air stream flowing from west to east, the swiftness of which is gale force the major part of the early season. Such prevailing circulation is, however, often subjected to short interruptions when cyclonic storm centers usually of marked intensity come from the United States and cross the ice regions. Now, during the latter half of the ice season the unequal rate of solar warming between land and water causes the wintertime high pressure to transfer from the land and increase over the ocean, thereby placing the Grand Banks region on the northwest side of a huge clockwise wind system. Gradients also become much reduced in steepness from what are found in winter season, and the warm southerly winds blowing over the icy waters around the Grand Banks bring a fog sheet which often does not lift for weeks at a time. This comprises a general survey of the two main types of weather and incidently it emphasizes two of the greatest handicaps the patrol is forced to encounter, namely early season gales and later season fogs.

If we return to a survey of the 1926 ice season we find no features of especial significance beyond the continuance of cyclone and anticyclone in alternate sequence following each other across the meteorological map from west to east, and in general with the progress of the season, gradients becoming gentler, winds weaker, and vortices traveling slower.

An interruption in the regularity of undulations to which the troposphere was subjected by alternate "highs" and "lows," occurred May 27 to June 2, when a great anticyclone built up and spread over the entire Atlantic seaboard from Florida to Newfoundland. It is rare to have such an atmospheric distribution but it means clear visibility and northerly winds for the ice regions; really the best weather we get on patrol.

DEVELOPMENT OF SUMMER TIME CONDITIONS

Going into June we began to notice the gradual development of the summer time Azorean high pressure as the thermal seesaw swung the opposite way from that observed at the beginning of the ice season.

At this time southwesterly winds began to blow with greater frequency and longer duration along the Atlantic seaboard of North America, and the ice regions being in the periphery of this system came under the effects of the southwest air stream more and more. The first real evidences of a hot wave over the United States was perceived the latter part of June.

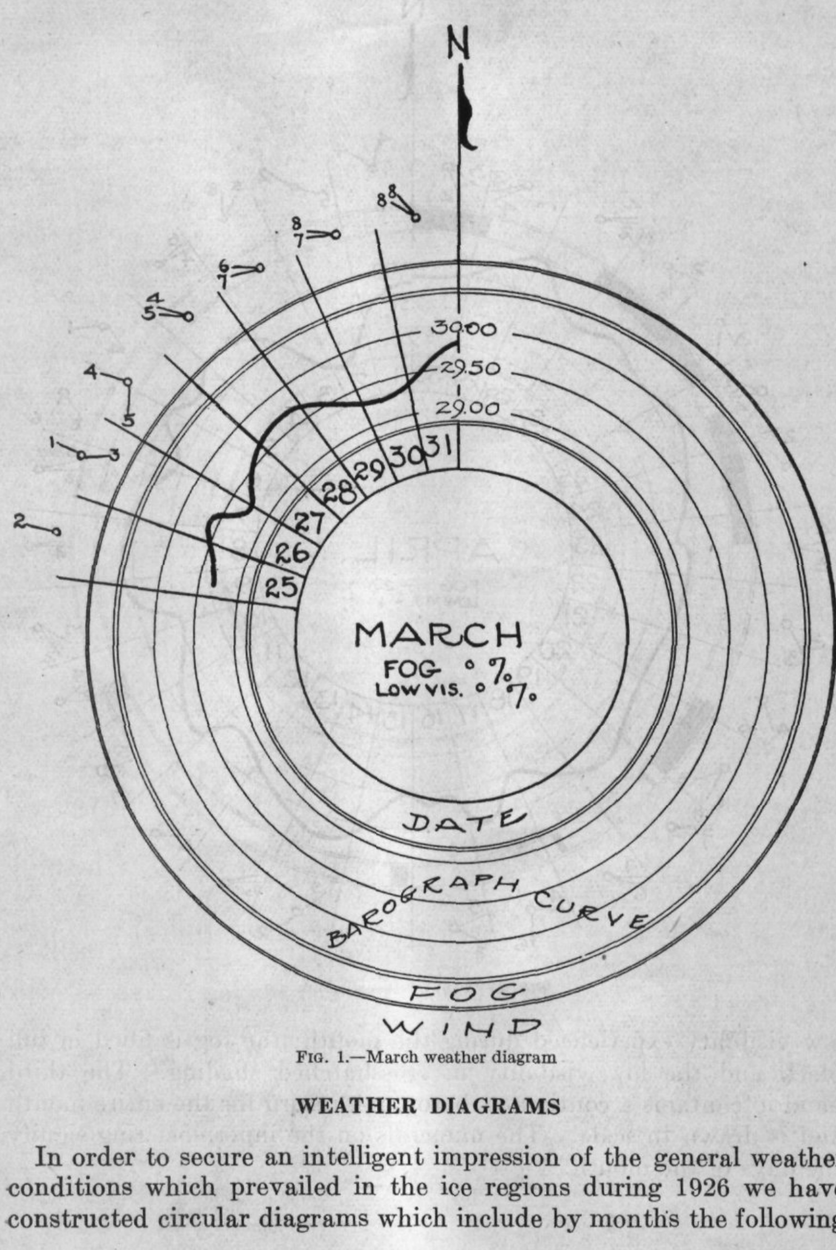

FIG. 1.—March weather diagram

WEATHER DIAGRAMS

In order to secure an intelligent impression of the general weather conditions which prevailed in the ice regions during 1926 we have constructed circular diagrams which include by month's the following information: Each diagram represents a month's time and is divided into 30 or 31 equal sectors in accordance with the number of days. The outer margin gives the wind direction averaged for each 12-hour period and also the force in terms of Beaufort scale. The next adjacent ring contains information on the amount of fog and

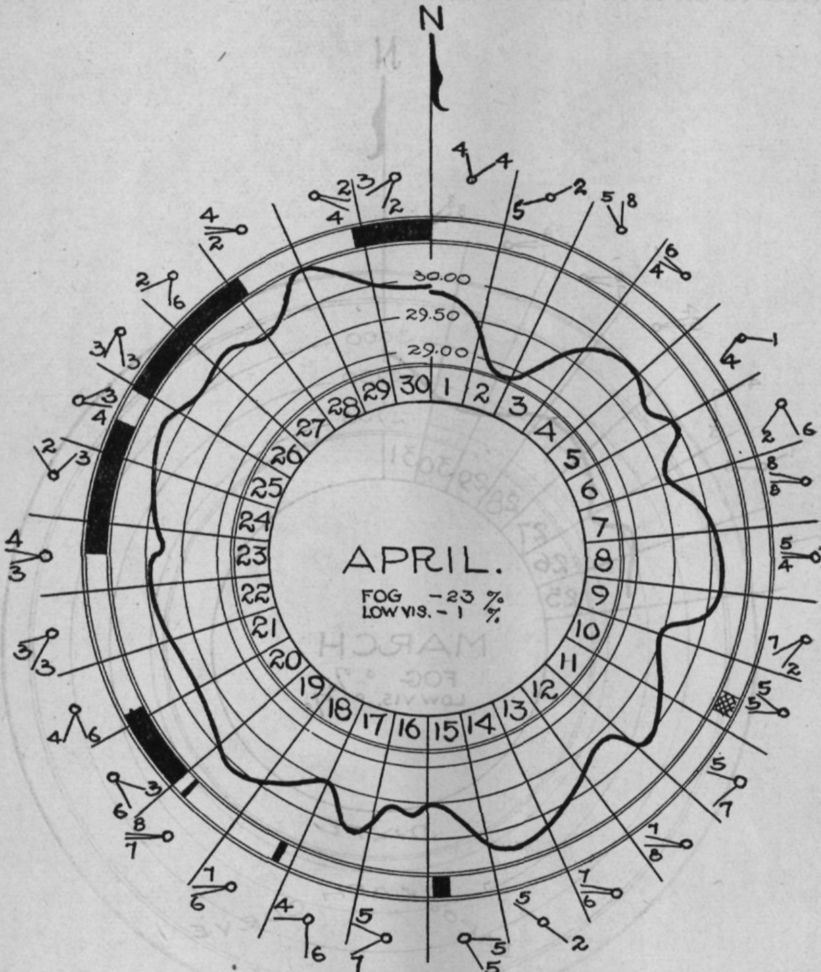

FIG. 2.—April weather diagram

low visibility experienced during the month; the fog is filled in full black and the low visibility in crosshatched shading. The third band in contains a continuous barograph record for the entire month and is drawn to scale. The numerals on the innermost ring signify the days of the month.

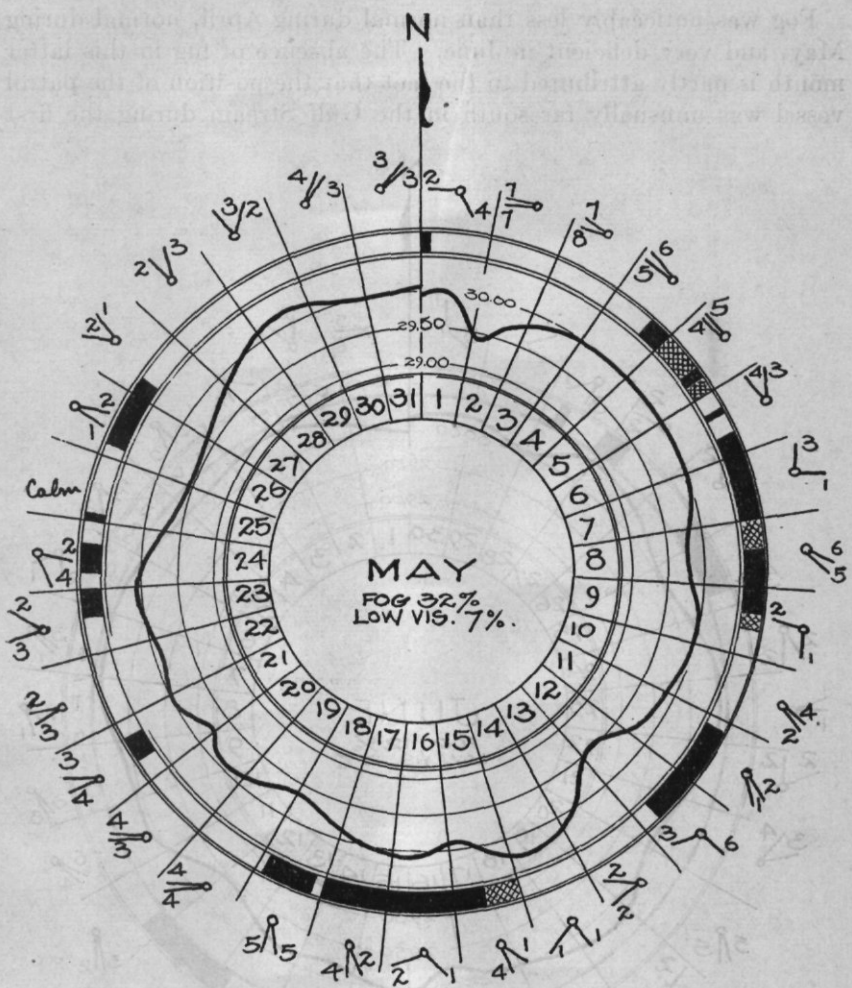

FIG. 3.—May weather diagram

Month	Percentage (hours)		Gales (number of days)[1]	Winds (average force)	Calms (number)[2]
	Fog	Low visibility			
March:					
Actual	0	0	3	5.0	0
Pilot chart	31				
April:					
Actual	23	1	9	3.8	0
Pilot chart	42				
May:					
Actual	32	7	2	3.1	1
Pilot chart	33				
June:					
Actual	12	2	0	2.8	2
Pilot chart	55				

[1] Based on 6 days in March. Gales per 12-hour periods. [2] Based on 12-hour periods.

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Fog was noticeably less than normal during April, normal during May, and very deficient in June. The absence of fog in this latter month is partly attributed to the fact that the position of the patrol vessel was unusually far south in the Gulf Stream during the first

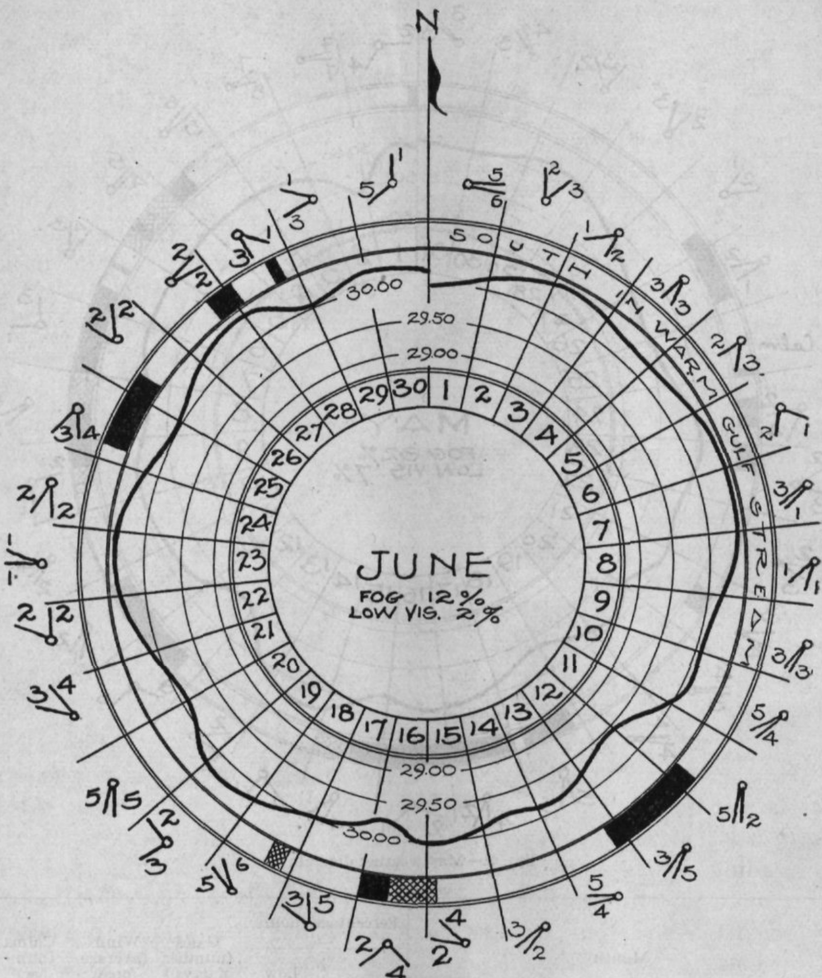

FIG. 4.—June weather diagram

half of the month and thus experienced clear weather. If she had been in the cold waters around the Tail of the Bank it is believed that almost constant fog would have been the order of the days.

CYCLONE TRACKS

Since the development and the passage of cyclones from the interior of the United States out across the ice regions is one of the most absorbing meteorological events with which we deal on patrol, perhaps it will be of interest and instruction to describe the paths of some of the cyclones, rate of motion, and sequence in the procession which was observed.

MARCH

The weather conditions on March 25, our sailing day from Boston, consisted of a trough of low pressure stretched along the Ohio and St. Lawrence River Valleys and embracing a well marked center which was progressing northeastward. It was rather interesting to watch the path of this disturbance which has been plotted on Figure 5, page 38, as track A. The center, during the night of March 26, curved to the right and followed a southeasterly path to the vicinity of Sable Island. At 8 a. m. on the 27th it was located again on the weather map off Sydney, Cape Breton, and thence it moved in the more frequently traveled route toward the northeast. The excursion to the southward of the usual cyclone path was attributed in this case to the presence of a deficiency of pressure over the Carolinas combined with the blocking influence of a high pressure area to the northward. The subsequent behavior of this disturbance is worth a word or two. It can be seen by Figure 5, page 38, that the center moved northeastward for two days when somewhere east of Newfoundland it deepened and thus intensifying the gradient gave to the Grand Banks region strong westerly winds for several days. On March 31 an excess of air accumulated to the westward over the United States in sufficient proportions finally to remove all effects of our storm offshore into the ocean. (For a daily record of winds, pressures, and fog, reference may be made to the weather diagram, fig. 1, p. 33.)

APRIL

During the early part of the ice season the atmospheric envelope we repeat for emphasis, is usually in violent agitation; rocked intermittently, so to speak, as successive cyclonic vortices disturb the prevailing atmospheric pressure distribution. The normal pressure character for this time of year is one to which we have previously referred as wintertime, and is clearly identified by a dominating excess of pressure lying over the cold continental area as compared with the air mass over the warmer ocean. No sooner had March 31 marked the disappearance to the eastward of the storm center described above than it also ushered in a similar vortex in the troposphere, first noticed on our map for the eastern United States just south of Chicago, Ill. The career of this cyclone across the country and out to sea, March 31 to April 3, has been traced as track B, Figure 5, page 38. The effect of its approach was first detected when at a distance of 500 miles from the ice patrol ship, the barometric pressure began to fall the afternoon of April 1. The northwesterly winds which had been blowing with great intensity and duration ceased about this time and a breeze sprang up from the northeast. The barometer continued to fall until noon the 2d, when it recorded what proved to be the minimum for the entire patrol (28.90; see weather diagram for April), and the depression must have passed about over our position south of Newfoundland. The winds with the passing of the center almost immediately shifted to northwest and increased that night to gale force. While we were still within the effects of the storm described above, a region of new depression was observed over the lower Mississippi River Valley. The path followed by this disturbance from April 2 to 7 is shown as track D, Figure 5. This center traveled along a path located a little farther to the northward than that of its predecessor. It followed a straight line more or less

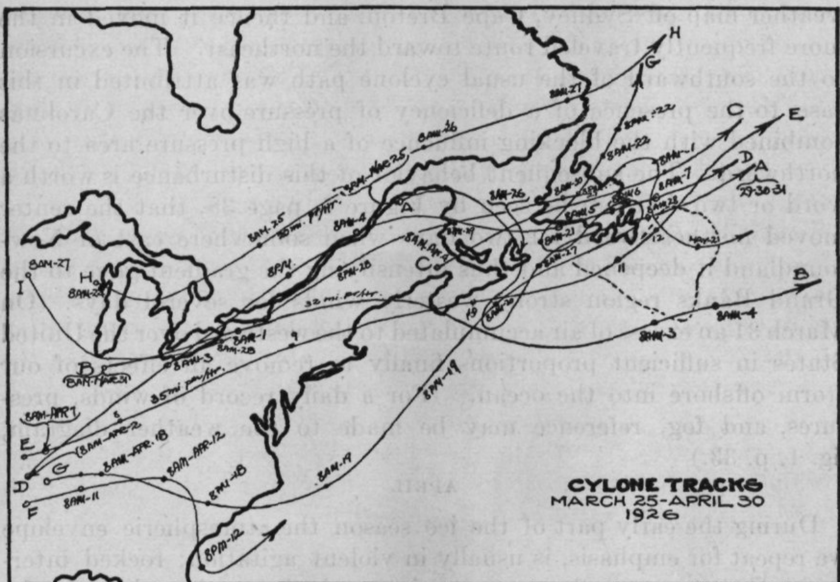

FIG. 5.—March and April cyclone tracks

up the St. Lawrence Valley until it arrived at the upper reaches of the gulf when it curved off to the right keeping over the water as much as possible, and slowly crossed southern Newfoundland on the 5th, 6th, and 7th. It is important to note that this cyclone, similar to several others which have been observed, deepened and intensified as it proceeded up the St. Lawrence River and Gulf. It deepened from a reported pressure in Mississippi of 29.76 to a minimum of 29.28 at Port aux Basque, Newfoundland, and it was at this point approximately 450 miles from the patrol ship that the first effects of the disturbance were felt. The wind shifted to southerly and the barometer fell but as the disturbance began to recede to the eastward it also began to occlude and the winds soon resumed their prevailing northwesterly direction.

While the foregoing storm was raging over Newfoundland another cyclone was growing down in Oklahoma. Its path from April 6 to 12 is lettered E on Figure 5. It followed the mean northeasterly track, as can be seen on the figure, and on the evening of the 11th when 300 miles from the position of the patrol ship it made its first effects felt by the wind increasing to nearly gale force from the south. As the storm moved away out into the North Atlantic we were completely enveloped in an anticyclone which was following on the rear of the "low," and for the next two days we experienced stiff northwesterly gales.

A moderate depression was observed on the meteorological map for 8 a. m., April 10 as centered in eastern Texas. It traveled very slowly in an easterly direction until the 12th when near Atlanta, Ga., it abruptly turned and followed a track almost due south for about 300 miles then reversed itself and moved northeastward. This peculiar behavior was believed due to the presence of an anticyclone of considerable size and intensity to the northward. The disturbance later spread southeastward over the Middle Atlantic States effectually blocking the normal cyclone path.

Track H of a cyclone, April 24 to 27, lay farther north than the other tracks for the month and being so far removed from the Grand Banks region its passing influence could not be detected on the barograph record. Track I, however, the last one for the month, lay up the St. Lawrence Valley so that the center, when it crossed the gulf the night of the 29th, was about 540 miles from the patrol. At this distance it caused our pressure to fall slowly and the winds to shift temporarily from west to east. The rate of travel of this cyclone was about 25 to 30 miles per hour. The month closed with this disturbance central over Newfoundland.

MAY

On May 1 the cyclone that had moved along track I began to drift southeasterly toward the patrol ship and consequently left a graphic record of a sharp bend in our barograph curve for the 2d instant. (See weather diagram for May, fig. 3, p. 35.)

The weather map which we compiled on board the morning of May 2 indicated another depression (29.70) forming to the westward over the Great Lakes region. First it followed an easterly path to the vicinity of Quebec where it hovered until May 3, then curved into northern Vermont and deepened to 29.30. April 4 it passed over the Gulf of St. Lawrence still intense (29.22), yet that evening it suddenly and surprisingly began to fill and by the following day it was very shallow and trough-like. May 6 it was almost squeezed out between two prominent areas of high pressure which merged and for several days prevented the regular procession of depressions which had been in effect prior to this.

It is interesting to observe that the easterly position of cyclone track B on Figure 6, was due without much doubt to the presence of the aforementioned anticyclone. Weather bulletins were received May 5, 6, and 7, containing information that a depression was forming in the region of Bermuda, but due to the lack of ship reports it was impossible to ascertain definitely the movement of the center. During the night of May 8 our barometer began to fall, which from past experience indicated the approach of a storm within a radius of about 500 miles. The next morning upon constructing the weather map the center was revealed near Port aux Basque; it probably had followed a northerly path from Bermuda as indicated on Figure 6. During the next few days the weather maps indicated a tendency of

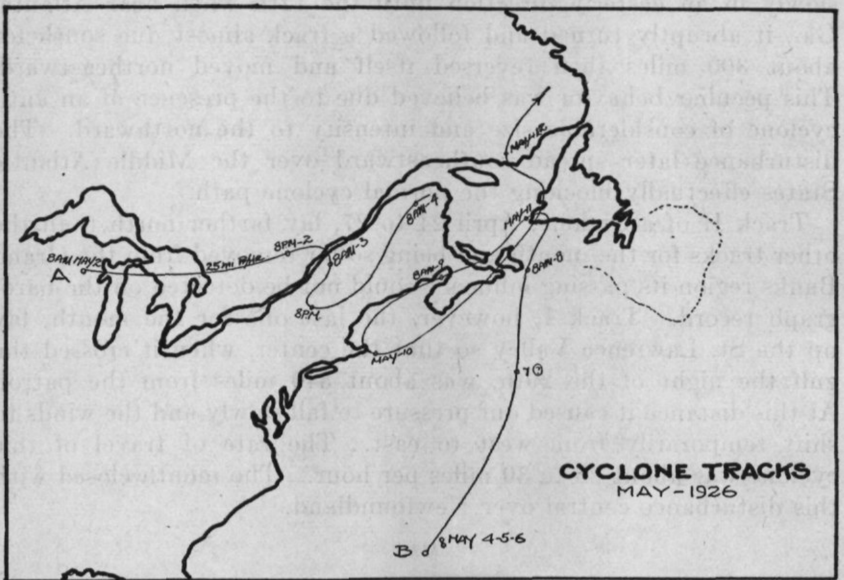

FIG. 6.—May cyclone tracks

the pressure to remain relatively low to the westward, depression centers being recorded from Nantucket to Sydney. On May 11 a deep center appeared near Sydney and moved in a path across the Gulf of St. Lawrence and out to sea. The effects of this distribution set up an indraft of southeasterly winds consisting of warm moisture-laden air pulled across the ice regions from out in the Atlantic. This condition incidently produced the longest period of fog which we experienced for the season.

The two weeks from the 13th to the 27th marked a change in the previously noted tendency of the cyclones to travel consistently along northeasterly tracks Where prior to this period individual centers moved rapidly across the country we now saw several small vortices (families) following meandering paths as if they were the prey to several factors no one of which exerted outstanding control. For example, on May 13 a slight shallow depression moved from Illinois eastward to the Potomac and the next day spread into a spacious depression with two centers. One traveled eastward while the other remained stationary until two days later it coalesced with a third depression which had been drifting slowly eastward from the Great Lakes. Contemporary with this modification in the weather we noticed that the wind velocities in general had gradually become less than they had been earlier in the season.

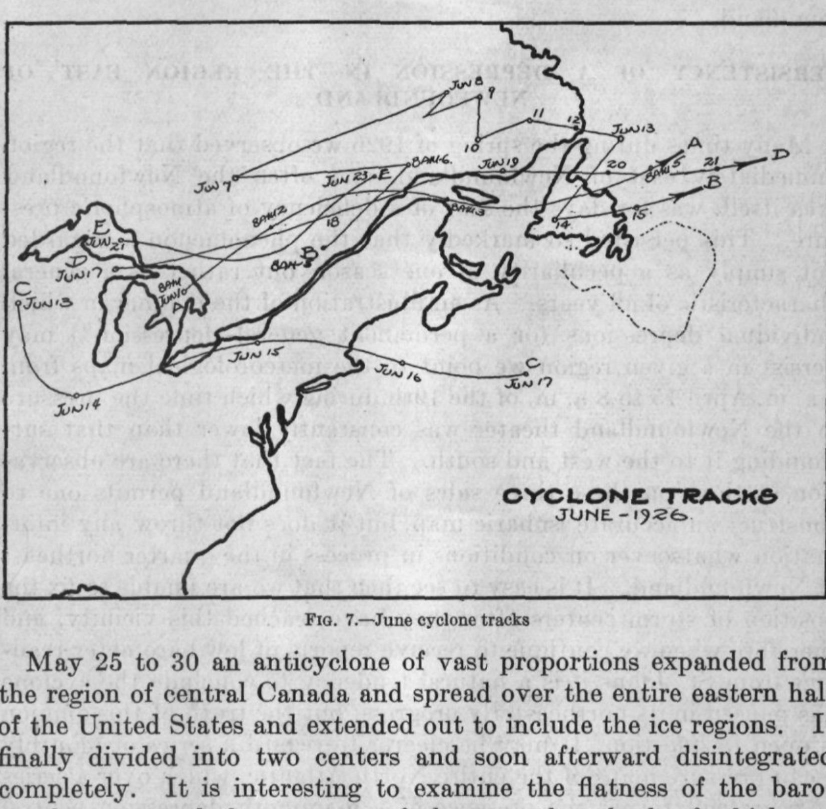

FIG. 7.—June cyclone tracks

May 25 to 30 an anticyclone of vast proportions expanded from the region of central Canada and spread over the entire eastern half of the United States and extended out to include the ice regions. It finally divided into two centers and soon afterward disintegrated completely. It is interesting to examine the flatness of the barograph curve and the presence of clear weather, both of which are recorded on Figure 3, page 35.

JUNE

The most important lesson contained in the cyclone tracks for June (fig. 7) is obtained by comparing the position of the average with the position of the average for the months of March and April. It is clearly indicated that a migration to the northward of the mean cyclone track took place in the course of two months. It is estimated as approximately 150 miles. The explanation for track C, Figure 7, being much farther south than the others is to be found when reference is made to the daily weather maps. An anticyclone of considerable strength spread southward out of the region north of the St. Lawrence River and probably tended to push cyclone C farther south than it would otherwise have traveled.

The next most striking weather feature in June was the increased number of cyclone families which bred in central North America and persisted in occupying pretty much all of the region northward of a front that extended from the Great Lakes to east of Newfoundland.

PERSISTENCY OF A DEPRESSION IN THE REGION EAST OF NEWFOUNDLAND

Many times during the spring of 1926 we observed that the region immediately east of Newfoundland, and often the Newfoundland area itself, was for days the seat of a deficiency of atmospheric pressure. This persisted so markedly that the phenomenon is regarded not simply as a peculiarity of one season but rather as a general characteristic of all years. As an illustration of the manner in which individual depressions (or a permanent general depression?) may persist in a given region we point to the meteorological maps from 8 a. m. April 15 to 8 a. m. of the 19th during which time the pressure in the Newfoundland theater was constantly lower than that surrounding it to the west and south. The fact that there are observation stations on these three sides of Newfoundland permits one to construct an accurate isobaric map, but it does not throw any information whatsoever on conditions in process in the quarter northeast of Newfoundland. It is easy to see then that we are unable to fix the position of storm centers after they have reached this vicinity, and therefore when we continue to receive reports of low barometer readings from St. Johns it is a natural tendency to conclude the cyclone has paused in its northeasterly progress, but the truth of this opinion is open to question. It may be clearer to regard a series of monthly mean pressure maps of the entire North Atlantic, which over a series of years will reveal the presence of a mammoth depression central near Iceland. It is believed that the continual presence of a depression observed east of Newfoundland on the ice patrol weather maps is in reality the western influence of the great Icelandic minimum accentuated by convergence while crossing Newfoundland of individual North American cyclone centers.

THE STRUCTURE OF A STORM AND ITS PROBABLE PATH

It may be instructive to devote a few very brief remarks to the new ideas in meteorology on the structure of cyclones (storm depressions) and their probable lanes of travel. Forecasters in the past have usually been guided by the mean cyclone track, as compiled by the statistician, and the barometric tendency gained by simultaneous observations from scattered meteorological stations. Probably some of the most valuable recent contributions to the forecasting art are the investigations of Bjerknes into the structure of cyclones. Detailed analysis of individual cyclones revealed the following two main types of classification:

(*a*) Cyclones which have a definite warm sector separated from the cold part by definite surfaces of discontinuity.

(*b*) Cyclones exhibiting no such individual parts at the surface of the earth.

The former are young intensifying storm centers while the latter are old ones which tend toward retardation in their paths. When they are treated separately a real discovery was made that class A cyclones move in the direction of the air current in the warm sector and very nearly with the same speed as the velocity of the air in that sector. Since the direction of the wind is taken along the isobars, the direction of travel of the storm center shown in Figure 8, page 44, is AB. The isobars in the warm sector are drawn nearly straight because it is found in general practice that they are quite flat. The speed of the cyclone is found by multiplying the distance between the isobars by the sine of the latitude. The whole wind system is in motion and as a rule the direction of the isobar AB in the northern hemisphere will swing anticlockwise and the path of the center O will gradually curve to the left. Sometimes, however, when a small cyclone moves along the edge of a warm anticyclone the change is in the opposite direction. Bjerknes at the Geophysical Institute, Bergen, has found that class B cyclones although not having distinct discontinuity surfaces such as class A exhibit on the earth's surface, do have weather characteristics which correspond to these latter and which do furnish similar information on the career of class B cyclones.

The cyclone is said to be born when two air masses of differing densities come within proximity of each other; the thermal character of the two bodies is the usually accepted index. There follows a period of growth with a corresponding increase in intensity so long as the structure is fed by a sufficient supply of cold and warm currents. Class A cyclones eventually begin to fill up or occlude as the lower limits of the warm sector lift off the earth's surface and shallow out. They are then known as class B cyclones, and the discontinuity surfaces are only to be found at increased heights in the troposphere.

A great number of the storms which affect the ice regions in early season are class A cyclones and it is quite often the case that we are able to observe the passage of the surface of discontinuity in many well-developed disturbances. The first line of discontinuity to sweep across the observer's position is termed the warm front and this carries along with it the greatest abundance of precipitation. Coincident with the passage of the warm front the winds haul abruptly and also abate in force. The warm sector is characterized by warm moisture-laden air, overcast skies, reduced visibility, less intense winds and occasional rain showers. The second line of discontinuity is called the cold front and squall line. The direction of the wind at this place

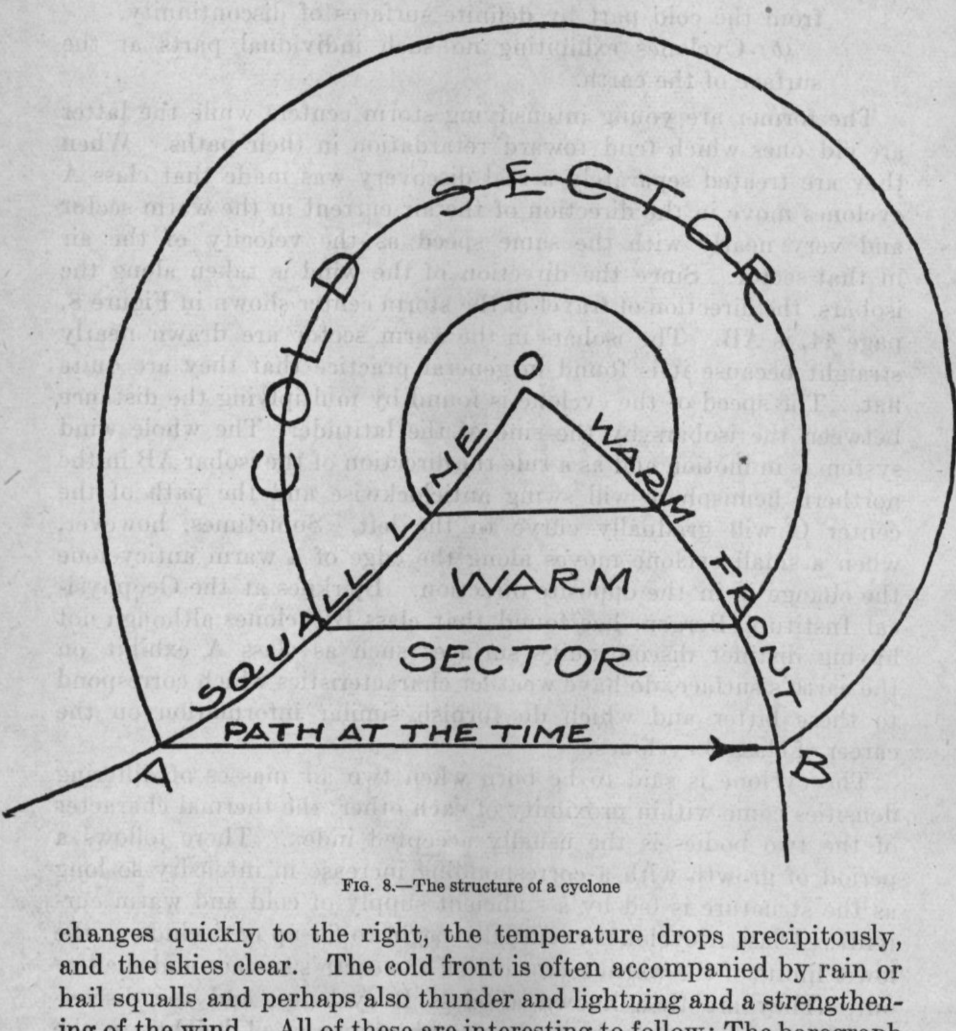

FIG. 8.—The structure of a cyclone

changes quickly to the right, the temperature drops precipitously, and the skies clear. The cold front is often accompanied by rain or hail squalls and perhaps also thunder and lightning and a strengthening of the wind. All of these are interesting to follow: The barograph curve, the wind velocity and direction, the air temperature, and the precipitation during the passage of some of the storms we experience on patrol. Often one can preceive how definitely, even in a crude way, the general structure of a cyclone can be traced.

COOPERATION WITH THE UNITED STATES WEATHER BUREAU

As was done on previous patrols a meteorological map was constructed twice daily on board ship, the data being obtained from the general synoptic reports broadcasted by the United States Weather Bureau from Arlington at 10 a. m. and 10 p. m. In addition to this the patrol ship was furnished with a daily forecast especially prepared by the Weather Bureau. All this information was broadcasted by phone to approaching steamers immediately following the ice broadcasts. The report on fog conditions was one of the most important features of this service from the standpoint of the steamship captain. The element of fog to the Grand Banks region, it is obvious, greatly increases the ever-present danger of collison with ice.

Twice daily, at 8 a. m. and 8 p. m., a weather report was dispatched to the United States Weather Bureau, Washington, D. C., and at the end of each cruise a more detailed report was forwarded by mail to Washington weather officials.

ICE FORECASTING BY MEANS OF THE WEATHER

One of the more important scientific problems that has confronted the ice patrol for some time is the desire to obtain advance information regarding the annual amount of ice to be expected south of Newfoundland. If the master of the *Titanic* had known, as we can clearly see to-day, that the year 1912 was one in which icebergs by the hundreds invaded the North Atlantic to low latitudes, he would probably have navigated his command farther south, and more cautiously, past the Arctic ice barrier. The amount of ice drifting out of the north into the open Atlantic is subject to great annual variations, for instance, in 1912 there were approximately 1,200 bergs counted south of Newfoundland while in 1924 there were only a total of 11. Several investigations[1, 2, 3] have been made of the relation between the amounts of ice in the northeastern North Atlantic and logical contributary factors, but only a few similar papers have dealt with the ice stream past Newfoundland.[4, 5]

All of the investigators, Schott, Mecking, Brenneck, Weisse, and Meinardus found that the wind was the most important factor which governs the southward drift of Polar ice. The ice patrol with the assistance of the British Meteorological Office and more recently, the United States Weather Bureau, has begun an investigation into the

[1] Meinardus, W.: Periodische Schwankungen der Eisdrift. Ann. Hydr., Hamburg, 1906; pp. 148–149 227–239, 278–285.

[2] Weise, W.: *Polareis und atmospharische Schwankungen. Geo. Ann. Stockholm, 6* (1924); pp. 273–299.

[3] Brennecke, W.: Beziehungen zwischen der Luftdruckverteilung und den Eisverhaltnisse des Ostgroen landischen Meeres. Ann. Hydr., Hamburg, 1904; pp. 49–62.

[4] Mecking, L.: Die Eisdrift aus dem Bereich der Baffin Bai usw. Veroff. Inst. Meersk, Berlin 7, 1906; p. 148.

[5] Schott, G.: Uber die Grenzen des Treibeises bei der Neufundlandbank sowie uber eine Beziehung zwischen neufundlandischen und ostgronlandischen Treibeis. Ann. Hydr., Hamburg, 1904; pp. 305–309.

effect of the weather upon the distribution of icebergs. It is desired therefore under this section devoted to weather to give a brief account of the results so far of this research work. The period embraces 47 years, 1880–1926, a series of sufficient length to permit mathematical correlation, and in this respect it has an advantage over previous works.

The results differ somewhat from those previously obtained by Mecking in that the chief importance is assigned to the variations of the pressure difference between Belle Isle, in Newfoundland, and Ivigtut in southern Greenland, during the period December to March. The pressure difference directly affects the amount of field ice, and

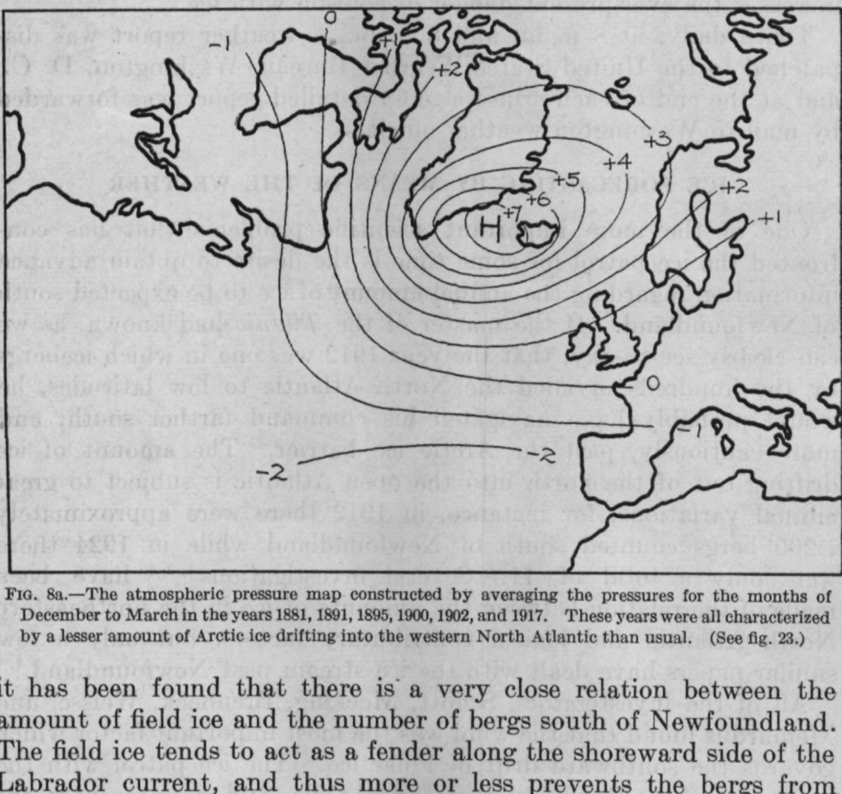

FIG. 8a.—The atmospheric pressure map constructed by averaging the pressures for the months of December to March in the years 1881, 1891, 1895, 1900, 1902, and 1917. These years were all characterized by a lesser amount of Arctic ice drifting into the western North Atlantic than usual. (See fig. 23.)

it has been found that there is a very close relation between the amount of field ice and the number of bergs south of Newfoundland. The field ice tends to act as a fender along the shoreward side of the Labrador current, and thus more or less prevents the bergs from stranding as they are borne southward. The truth of this statement was curiously revealed during the 1924 patrol, when the unusual absence of field ice left the season's crop of bergs to strand in northern waters. When the sea ice recedes northward, due to melting in May, the coast line becomes more and more exposed. Stranding takes place on a great scale, and the consequent supply of bergs to the Grand Banks is cut off. The iceberg menace to steamships in the North Atlantic would be greatly diminished, or practically disappear, if sea ice did not hamper the North American coast line from February to March every year. The pressure difference between Bergen and Stykkisolm during the period October to January was also found to be of importance.

The use of pressure difference between various points furnishes the best data for forecasting purposes, because there is no room for the personal bias which may come in when charts are classified according to types. A classification of the charts of pressure anomaly over the North Atlantic during the period December to March has, however, been made, and this distinctly reveals two types of pressure distribution—a plus type, in which an excess of pressure

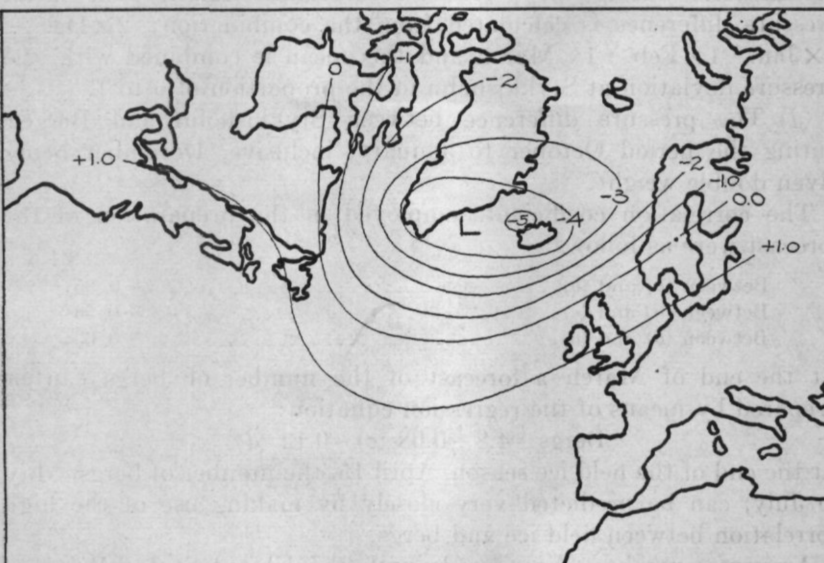

FIG. 8b.—The atmospheric pressure map constructed by averaging the pressures for the months December to March in the years 1885, 1890, 1903, 1912, and 1921. These years are characterized by a greater amount of Arctic ice drifting into the western North Atlantic than usual. (See fig. 23, p. 76.)

centered in the region of Iceland, more or less dominates the Atlantic north of the Azores (see fig. 8a, p. 46), and a minus type when reverse conditions prevail (see fig. 8b, p. 47). The plus type is subject to further classification into (1) and (2), depending upon a relatively great or moderate intensity of the excess pressure mass, both of which are reflected in a relatively very light, or light ice year, respectively, in the western North Atlantic. The minus type, although unmistakably showing a greater amount of ice than normal, does not permit subgrouping. In other words, the plus type of pressure conditions (fig. 8a) exhibit a higher correlation with poor ice years than do the minus type (fig. 8b) with correspondingly rich ice years. This indicates the presence of other factors, such as variations in the air and water temperatures in the far north, or variations in precipitation, or perhaps an unnatural phenomenon, such as an ice jam in the Arctic Archipelago.

Although the investigation is not yet completed at the present writing, the results already indicate a high degree of success for such a method of ice forecasting. Correlation coefficients have been calculated between the following variables:

(*a*) Number of bergs (on a scale of 0 to 10). (See fig. 23, p. 76.)

(*b*) Amount of field ice (on a scale of 0 to 10).

(*c*) Pressure difference (in millibars) between Belle Isle and Ivigtut, combined with a deviation of pressure from normal at Stykkisholm during the period December to March. The mean pressure difference is calculated from the combination: 2×Dec.+ **2**×Jan.+1×Feb.+1×March and this mean is combined with the pressure deviation at Stykkisholm in the proportion of 6 to 1.

(*d*) The pressure difference between Stykkisholm and Bergen during the period October to January, inclusive, December being given double weight.

The correlation coefficients employed in the preparation of the forecast were as follows:

Between (*a*) and (*b*)	+0. 85
Between (*a*) and (*c*)	−0. 58
Between (*a*) and (*d*)	−0. 63

At the end of March a forecast of the number of bergs can be prepared by means of the regression equation:

$$\text{Bergs} = 4.8 - 0.08\ (c) - 0.12\ (d)$$

At the end of the field ice season, April 15, the number of bergs, May to July, can be predicted very closely by making use of the high correlation between field ice and bergs.

Arrangements have been made with the United States Weather Bureau whereby that organization furnishes the ice patrol with the pressure data for the months October to March, inclusive, and upon which is based the forecast of bergs for the following spring season. The forecast for the ice season of 1926 was "a light ice year," (3.4 on scale 0–10), while as a matter of record it developed that we experienced very closely to "a normal season 4.3." It is fair to add that we were handicapped in making a forecast due to the absence of pressure data from a very critical area, that of Greenland. This difficulty will probably not arise again as Greenland meteorological stations are now connected with Europe by means of radio.

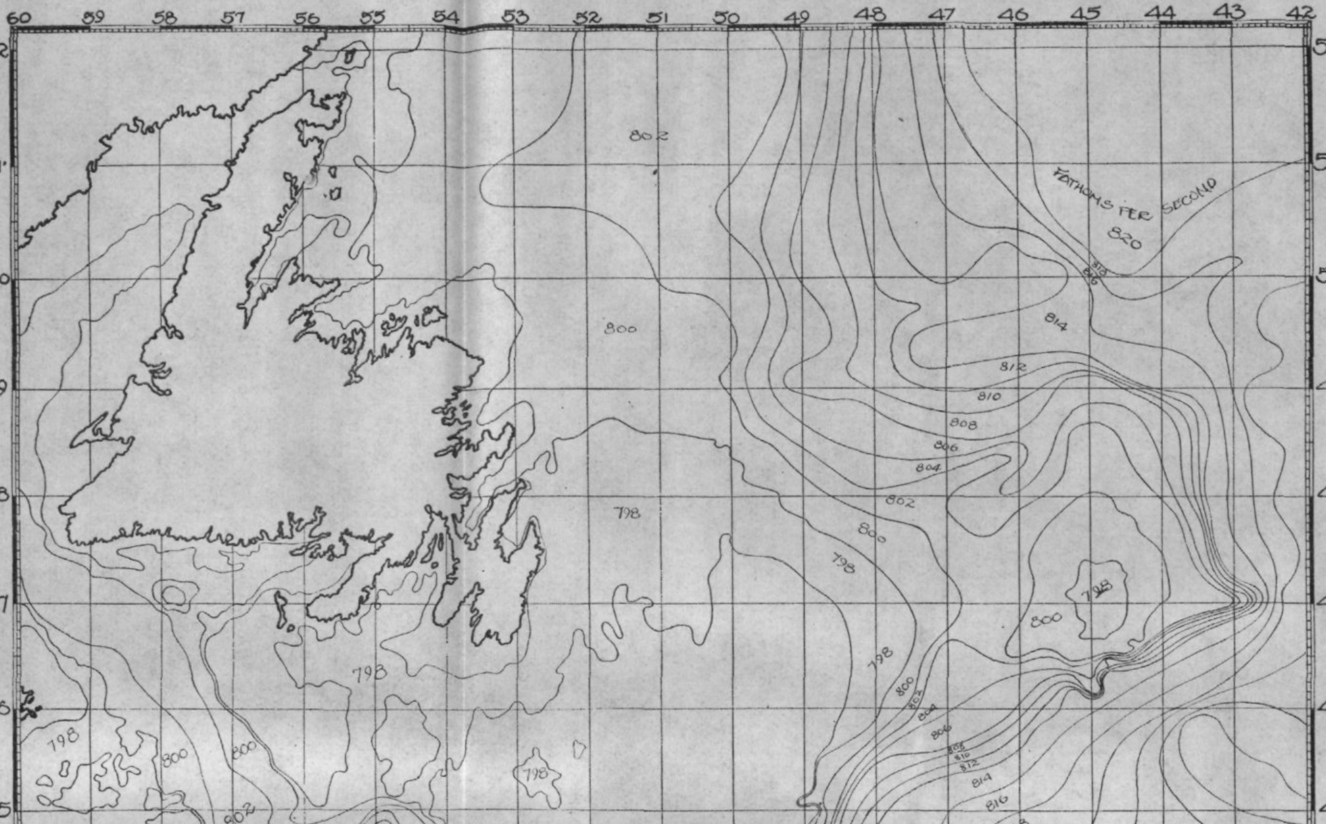

FIG. 9.—A chart for use with the sonic depth apparatus showing the velocity of sound in the water column around the Grand Bank

32036—27. (Face p. 49.)

SOUNDINGS CARRIED OUT WITH THE SONIC DEPTH FINDER

As a result of action on the part of the Interdepartmental Board on Ice Patrol at its regular meeting in the early part of 1924 one of the ice patrol ships, the *Tampa*, was equipped with a sonic depth finder of the United States Navy type. The main purpose of the board in having this apparatus installed was to test the practicability of locating icebergs by sonic means. A secondary object was to gain a more accurate knowledge of the bottom contour and consequently of the circulation in the ice regions. An account of the experimental work on icebergs in 1925 and the hydrographical soundings then taken are contained in the report of that year, Bulletin No. 13, page 45. No further work in connection with sound experiments on bergs was attempted in 1926. Arrangements, however, were made whereby a member of the United States Navy sound course at the New London school was detailed to the *Tampa* for the ice patrol. A program was drawn up to take as many soundings as practical to gain further material for a more accurate mapping of the bottom of the ice regions south of Newfoundland than is yet possible, and this work ought to be continued in the years to come. In accordance with the foregoing, a sounding was taken every hour, 8 a. m. to 10 p. m., while the *Tampa* was on duty this year with the result that a total of 465 observations were made.

In connection with this work a chart was constructed (fig. 9, p. 49) to include the ice regions south of Newfoundland showing by zones the velocity of sound after corrections had been made for the influences arising from pressure, temperature, and salinity. The distribution of salinity and temperature in the water mass in the ice regions is quite accurately known from the many oceanographic observations which have been compiled by the ice patrol. The correct velocity of sound in a water column of given temperature, salinity, and pressure is found by reference to very useful tables compiled by Heck and Service. (U. S. Coast and Geodetic Survey, Special Publication, No. 108.) The range of soundings made was from 23.5 fathoms to 2,850 fathoms. The list follows with date, hour, and latitude and longitude.

SOUNDINGS AS RECORDED WITH THE SONIC DEPTH FINDER, 1926

Date		Time (sixtieth meridian)	Position				Depth
			Latitude, north		Longitude, west		
			°	′	°	′	Fathoms
Mar.	26	1600	42	35	65	05	45.5
	26	1800	42	35	64	38	74.6
	26	2000	42	35	64	11	148.5
	27	0800	42	45	61	42	773.4
	27	1000	42	45	61	22	956.1
	27	1200	42	46	61	02	1,301.2
	27	1400	42	43	60	40	1,389.9
	27	1600	42	43	60	21	1,564.9
	27	1800	42	43	59	53	1,625.9
	27	2000	42	44	59	31	2,176.6
	27	2200	42	44	59	08	2,090.9
	28	0800	42	54	57	22	2,411.0
	28	1000	42	56	57	03	2,304.6
	28	1200	42	57	56	40	2,337.3
	28	1400	42	56	55	58	1,949.5
	28	1600	42	55	55	55	1,781.4
	28	1800	42	55	55	50	2,035.6
	29	0800	42	55	52	50	1,768.3
	29	1000	43	02	52	41	1,544.8
	29	1100	43	10	52	31	1,532.9
	29	1200	43	11	52	30	1,520.7
	29	1300	43	13	52	29	1,374.9
	29	1400	43	16	52	22	1,237.2
	29	1500	43	22	52	17	943.3
	29	1530	43	24	52	13.5	868.4
	29	1600	43	27	52	10	775.7
Apr.	1	1400	42	05	52	37	2,455.6
	1	1600	42	18	52	19	2,216.0
	1	1800	42	21	52	00	2,009.0
	1	2000	42	30	51	39	1,796.5
	1	2200	42	33	51	35	1,541.0
	2	0800	42	42.5	51	20	1,084.7
	2	1000	42	48	50	57	709.5
	2	1200	42	54.5	50	34	166.0
	2	1400	42	56	50	08	85.0
	2	1600	42	56	49	43	944.3
	2	1800	42	57	49	31	685.4
	2	2000	43	07	49	27	685.4
	4	0930	43	29.5	49	33.5	43.0
	4	1000	43	29.5	49	27.5	48.6
	4	1030	43	29	49	22	69.0
	4	1100	43	29	49	15	85.3
	4	1130	43	28.5	49	09	120.7
	4	1200	43	32	49	07	572.8
	4	1300	43	41	49	03	544.7
	4	1400	43	50	48	58	143.0
	4	1500	43	58	48	54	120.7
	5	0800	43	47	49	16	402.0
	5	1000	44	04	49	11.5	157.2
	5	1200	44	02	49	14	44.3
	5	1400	43	45	49	19	381.8
	5	1600	43	27	49	20	202.0
	5	1800	43	15	49	16	382.0
	8	1030	43	47	50	24	33.7
	8	1200	43	44.5	50	16	29.0
	8	1300	43	41	50	02	33.0
	8	1400	43	37	49	51	36.0
	8	1500	43	33.5	49	39	38.3
	8	1600	43	29	49	27	59.1
	8	1700	43	38	49	20	224.0
	8	1800	43	45	49	13	502.0
	9	0800	43	47	48	39	1,347.3
	9	0900	43	52	48	21.5	1,676.0
	9	1000	43	58	48	14	1,789.0
	9	1100	44	04	48	17.5	1,768.3
	9	1200	44	13	48	20	1,752.1
	9	1300	44	18	48	08	1,894.5
	9	1400	44	14	48	01	1,874.7
	9	1500	44	11	47	50.5	2,073.4
	10	1200	43	15	48	21	1,680.0
	11	0800	42	55	51	19	321.3
	11	1000	42	55	51	26	723.3
	11	1200	43	00	51	58	1,403.8
	11	1400	43	02	52	25	1,626.0
	11	1600	43	06	52	52	1,809.0
	11	1800	43	08	53	22	1,919.6
	11	2000	43	13	53	46	2,205.2

Date		Time (sixtieth meridian)	Position				Depth
			Latitude, north		Longitude, west		
			°	′	°	′	Fathoms
Apr.	11	2200	43	14	54	03	2,337.3
	12	0800	43	13	53	46	2,299.0
	12	1000	43	13.5	55	20	2,310.3
	12	1200	43	08	55	30	2,310.3
	12	1400	43	09	55	42	1,908.5
	12	1600	43	07	55	56	1,929.0
	12	1800	43	08	56	13	2,047.0
	12	2000	43	08	56	33	2,018.3
	12	2200	43	08	56	47	2,047.0
	13	0800	43	20	58	34	1,771.2
	13	0900	43	22	58	47	1,564.8
	13	0930	43	22	58	53	1,564.8
	13	1000	43	22	59	00	1,289.0
	13	1030	43	22.5	59	06	1,386.4
	13	1100	43	24	59	11	1,217.0
	13	1130	43	25	59	17	1,172.4
	13	1200	43	27	59	25	1,153.4
	13	1330	43	31	59	44	774.[illegible]
	24	0830	43	53	61	17	31.
	24	0900	43	51	61	10	36
	24	0930	43	50	60	54	25.
	24	1000	43	48	60	50	23.[illegible]
	24	1030	43	46.5	60	45	30.1
	24	1100	43	45	60	46	32.2
	24	1200	43	39	60	20	42.6
	24	1300	43	38	60	11	55.3
	24	1400	43	34	59	52	674.0
	24	1500	43	30	59	37	1,302.8
	24	1600	43	26	59	22	1,381.2
	24	1700	43	23	59	12	1,443.2
	24	1800	43	21	59	03	1,838.1
	24	1900	43	18	58	53	1,689.2
	24	2000	43	06	58	43	2,011.7
	24	2100	43	03	58	31	1,992.2
	24	2200	43	00	58	18	1,944.4
	25	0800	43	04	56	37	2,072.7
	25	0900	43	04	56	30	2,072.7
	25	1000	43	04	56	26	2,099.3
	25	1100	43	04	56	16	1,972.9
	25	1200	43	07	56	09	2,052.0
	25	1300	43	07	55	52	2,052.0
	25	1400	43	04	55	38	1,954.0
	25	1500	43	04	55	22	2,311.5
	25	1600	43	03	55	05	2,248.3
	25	1700	43	03	54	53	2,225.5
	25	1800	43	02	54	48	2,225.5
	25	1900	43	02	54	39	2,225.5
	25	2000	43	00	54	30	2,255.9
	25	2100	42	59	54	21	2,322.7
	25	2200	42	58	54	12	2,392.7
	26	0800	43	02	53	14	2,008.0
	26	1000	42	55.5	52	59	2,008.0
	26	1100	42	58	52	58	2,008.0
	26	1200	43	02	52	50.5	2,008.0
	26	1300	43	07	52	46	1,842.1
	26	1400	43	11	52	39	1,680.8
	26	1600	43	18	52	34	1,563.0
	26	1630	43	21	52	31	1,518.4
	26	1700	42	23	52	29	1,436.4
	26	1730	43	25	52	26.5	1,273.0
	26	1800	43	28	52	24.5	1,220.6
	26	1830	43	29	52	23	1,058.8
	26	1900	43	31	52	21	954.2
	26	1930	43	33	52	18	940.7
	26	2000	43	34	52	18	940.7
	28	0800	43	53	51	20	41.3
	28	0900	43	43	51	18	37.8
	28	1000	43	33	51	15	48.8
	28	1100	43	22	51	13	59.5
	28	1200	43	13	51	10	191.2
	28	1300	43	02.5	51	06.5	771.3
	28	1400	42	59	51	04	811.1
	28	1500	42	50	51	10	943.1
	28	1600	42	43	51	17	1,087.2
	28	1700	42	41	51	19	1,243.7
	28	1800	42	32	51	28	1,383.1
	28	1900	42	24	51	32	1,501.2

Soundings as recorded with the sonic depth finder, 1926—Continued

Date	Time (sixtieth meridian)	Position: Latitude, north °	'	Position: Longitude, west °	'	Depth
		°	'	°	'	*Fathoms*
Apr. 28	2000	42	22	51	34	1,582.3
28	2100	42	17	51	39	1,723.9
28	2200	42	08	51	46	1,759.9
29	0800	41	27	51	02	2,246.9
29	0900	41	24	50	49	2,442.6
29	1000	41	20	50	37	2,276.1
29	1100	41	13	50	25	2,276.1
29	1200	41	06	50	16	2,044.8
29	1300	41	06	50	16	2,044.8
29	1500	41	21	50	16	1,921.4
29	1600	41	27	50	16	2,012.8
29	1700	41	34.5	50	16	2,012.8
29	1800	41	45.5	50	16	2,012.8
29	1900	41	47	50	17	1,964.5
29	2000	41	56	50	17	1,878.6
29	2100	42	06	50	17	1,742.4
29	2200	42	08	50	17	1,701.5
29	2240	42	14	50	17	1,627.3
29	2300	42	17	50	17	1,596.0
29	2320	42	20	50	17	1,426.4
29	2340	42	23	50	17	1,432.8
30	0000	42	25	50	17	1,432.8
30	0020	42	27.5	50	17	1,322.3
30	0040	42	29	50	17	1,290.3
30	0800	42	38	49	45	1,136.6
30	0900	42	41	49	39	1,170.5
30	1000	42	38	49	36	1,200.0
30	1100	42	34	49	29	1,344.9
30	1200	42	30	49	24	1,407.1
30	1300	42	28	49	20	1,437.2
30	1400	42	26	49	16	1,480.4
30	1500	42	22	49	10	1,522.2
30	1600	42	17	49	05	1,576.3
30	1700	42	12.5	48	56	1,602.3
30	1800	42	11	48	20	1,618.6
30	1900	42	10	48	49	1,639.5
30	2000	42	10	48	46	1,639.5
May 1	0800	41	49	48	14	1,912.4
1	0900	41	43	48	11	1,982.7
1	1000	41	37	47	59	1,846.5
1	1100	41	30	47	47	2,033.3
1	1200	41	27	47	44	2,147.5
1	1300	41	22	47	35	2,130.2
1	1400	41	16	47	25	2,170.2
1	1500	41	09	47	15	2,182.0
1	1600	41	08	47	11	2,225.9
1	1700	41	15	47	14	2,205.4
1	1800	41	25	47	16	2,175.6
1	1900	41	35	47	18	2,145.0
1	2000	41	44	47	20	2,175.6
1	2100	41	53	47	23	2,175.6
1	2200	42	03	47	25	2,175.6
2	0800	42	56	47	37	1,805.5
2	0900	42	57	47	41	1,945.1
2	1000	42	58	47	45	1,846.5
2	1100	42	59	47	50	1,846.5
2	1200	43	00	47	54	1,825.7
2	1300	43	00	47	57	1,876.0
2	1400	43	01	48	01	1,876.0
2	1500	43	02	48	05	1,746.5
2	1600	43	02	48	09	1,746.5
2	1700	43	03	48	12	1,705.7
2	1800	43	03	48	14	1,705.7
2	1900	43	04	48	15	1,669.1
2	2000	43	05	48	22	1,602.3
3	0800	42	45	49	37	1,145.1
3	0900	42	47	49	40	1,136.6
3	1000	42	49	49	43	1,233.5
3	1100	42	51	49	43.5	1,105.5
3	1130	42	54	49	45	1,098.0
3	1200	42	52.5	49	44	1,091.8
3	1230	42	56	49	46	1,008.4
3	1300	42	57	49	46	990.0
3	1330	42	52	49	46.5	926.6
3	1400	42	59	49	47	896.9
4	0800	43	25	50	17	35.6
4	0900	43	26.5	50	18	38.1
May 4	1000	43	30	50	13	34.3
4	1100	43	30	50	00	34.3
4	1130	43	30	49	54	37.3
4	1200	43	30	49	47	36.3
4	1230	43	30	49	41	37.3
4	1300	43	30	49	35	36.3
4	1315	43	30	49	31	37.3
4	1330	43	30	49	27	50.2
4	1345	43	30	49	24	48.6
4	1400	43	30	49	21	52.7
4	1415	43	30	49	18	70.5
4	1430	43	30	49	14	125.9
4	1445	43	30	49	12	211.3
4	1500	43	31	49	10	422.4
4	1600	43	34	49	07	281.5
4	1700	43	40	49	05	414.8
4	1730	43	42	49	04	441.4
4	1800	43	43	49	02	441.4
4	1900	43	44	48	59	402.2
5	1000	43	37	48	06	1,871.7
5	1100	43	38	48	02	1,916.8
5	1200	43	32	48	14	1,770.1
5	1300	43	28	48	25	1,602.3
5	1400	43	26	48	28	1,602.3
5	1500	43	24	48	32	1,497.3
5	1600	43	21	48	41	1,393.5
5	1700	43	16	48	54	1,032.2
5	1800	43	07	49	02	1,003.9
5	1900	43	01	49	12	800.4
5	2000	43	02	49	26	687.0
27	0800	42	30.5	50	14	1,634.1
27	1000	42	20	50	11	1,634.1
27	1100	42	19	50	15	1,650.3
27	1200	42	17	50	26	1.634.1
27	1300	42	12	50	32	1,721.0
27	1400	42	19	50	42	1,618.0
27	1500	42	25	50	53	1,516.2
28	0800	42	13	50	15	1,814.7
28	0900	42	13	50	13	1,814.7
28	1000	42	13	50	12	1,814.7
28	1100	42	14	50	09	1,775.5
28	1200	42	15	50	13	1,814.7
28	1300	42	15	50	13	1,814.7
28	1400	42	16	50	16	1,795.1
28	1500	42	13	50	01	1,835.5
28	1600	42	10	49	48	1,856.3
28	1700	42	06.5	49	32.5	1,775.5
28	1800	42	03.5	49	18	1,646.2
28	1900	42	00	49	02	1,715.4
28	2000	41	57	48	48	1,752.5
28	2100	41	54	48	38	1,771.2
28	2200	41	52	48	26	1,851.8
29	0800	41	28.5	48	23	1,851.8
29	0900	41	26.5	48	23	1,831.0
29	1000	41	25.5	48	23	1,831.0
29	1100	41	24	48	23	1,831.0
29	1200	41	23	48	21	1,810.7
29	1300	41	21	48	21	1,790.7
29	1400	41	20	48	20	1,831.0
29	1600	41	18	48	19	1,831.0
29	1800	41	16	48	18	1,856.3
29	2000	41	13.5	48	16.5	1,992.2
30	0800	41	16	47	54	1,899.6
30	1000	41	13	47	52	1,899.6
30	1200	41	05	48	10	1,835.5
30	1400	40	56	47	56	1,835.5
30	1600	40	59	47	50	1,733.7
30	1800	40	58	47	49	1,790.7
30	2000	40	53	47	47	1,790.7
31	0800	40	47	47	42	1,899.6
31	1000	40	45	47	40	1,921.6
31	1200	40	44	47	38	1,899.6
31	1400	40	53	47	45	1,856.3
31	1600	41	06	48	02	1,835.5
31	1800	41	21	48	17.5	1,921.6
31	2000	41	33	48	32	1,835.5
31	2200	41	35	48	37	1,877.5

Soundings as recorded with the sonic depth finder, 1926—Continued

Date	Time (sixtieth meridian)	Position: Latitude, north		Position: Longitude, west		Depth
		°	′	°	′	*Fathoms*
June 2	0800	41	15	48	30	1,646.2
2	1000	41	15	48	30	1,646.2
2	1200	41	18	48	32	1,662.9
2	1400	41	24	48	25	1,697.5
2	1600	41	16	48	32	1,613.7
2	1800	41	11	48	37	1,662.9
2	2000	41	44	48	33	1,613.7
2	2200	41	42	48	34	1,646.2
3	0800	41	20	48	39	1,835.5
3	1000	41	40	48	43	1,752.5
3	1200	41	35	48	46	1,752.5
3	1400	41	25	48	44	1,810.7
3	1600	41	15	48	40	1,697.5
3	1800	41	04	48	38	1,662.9
3	2000	41	02	48	35	1,697.5
3	2200	41	00	48	30	1,697.5
4	1200	41	06.5	48	26	1,680.0
5	0800	40	57	48	36	1,733.7
5	1000	40	57	48	39	1,752.5
6	0800	41	23	47	50	1,795.1
6	1000	41	28	47	36	2,067.7
6	1200	41	40	47	27	2,094.2
6	1400	41	40	47	27	2,094.2
6	1600	41	36	47	30	2,094.2
6	1800	41	32	47	50	1,944.4
7	1800	41	56	48	49	1,815.1
7	2000	41	55	49	09	1,815.1
8	1000	41	31	48	54	1,907.9
8	1200	41	40	49	09	1,815.1
8	1400	41	52	49	21	1,815.1
8	1600	41	41	49	25	1,613.7
8	1800	41	35	49	38	1,690.6
8	2000	41	30	49	36	1,791.0
9	0800	41	42	49	10	1,795.1
9	1200	41	52	49	50	1,775.5
9	1400	41	41	49	59	1,733.7
9	1600	41	44	50	25	2,067.7
9	1800	42	07	50	22	1,944.4
9	2000	41	58	50	31	2,067.7
9	2200	41	57	50	29	2,046.8
10	1000	41	53	52	05	2,300.2
23	1300	44	27	63	16	48.4
23	1400	44	23	63	03	87.3
23	1600	44	16	62	36	97.6
23	1800	44	09	62	08	108.6
23	2000	44	02	61	46	77.2
23	2200	43	53	61	14	35.0
24	0800	43	01	59	28	1,733 7
24	1000	42	49	59	23	2,094.2
24	1200	42	37	59	13	2,273.9
24	1400	42	26	59	02	2,372.9
24	1600	42	12	58	50	2,524.7
24	1800	41	59	58	32	2,605.0
24	2000	41	57	58	02	2,524.7
24	2200	42	00	57	35	2,524.7
25	0800	42	02	54	07	2,524.7
25	1000	42	04	54	35	2,564.5
25	1200	42	05	54	01	2,564.5
25	1400	42	05	53	27	2,659.8
25	1600	42	06	52	55	2,748.3
25	1800	42	06	52	51	2,311.5
26	0700	43	06	52	39	1,671.8
26	0800	43	15	52	27	1,326.3
26	0820	43	18	52	24	1,079.0
26	0830	43	19	52	22	1,003.0
26	0840	43	20	52	20	902.3
26	0850	43	22	52	19	864.0
26	0900	43	23	52	16	837.0
26	0910	43	25	52	14.5	801.9
26	0920	43	26	52	13	701.0
26	0930	43	27.5	52	11	632.3
26	0939	43	29	52	10	496.4
26	1200	43	16.5	51	49	632.3
26	1400	43	00	51	23	620.2
26	1445	42	57	51	14	931.4
26	1600	42	50	51	19	1,003.0
26	1800	42	39	51	27.5	1,422.7
26	2000	42	22	51	40.5	1,776.3
27	0800	41	17	50	53	2,449.7
June 27	1000	41	10	50	20	2,311.5
27	1200	41	22	50	20	1,926.3
27	1400	41	36	50	20	2,126.3
27	1600	41	56	50	19	2,021.6
27	1800	42	19	50	18	1,738.0
27	2000	42	29	50	17	1,343.8
27	2030	42	35	50	17	1,116.2
27	2045	42	38	50	17	1,079.0
27	2100	42	40.5	50	17	1,041.7
27	2115	42	44	50	17	1,003.0
27	2120	42	45	50	17	938.9
27	2128	42	46	50	17	659.6
28	0000	42	49.5	50	03	246.9
28	0030	42	51	49	55	250.0
28	0100	42	53	49	47	448.6
28	0105	42	52	49	44	806.0
28	0800	43	02	49	23	701.0
28	0830	43	08	49	23	782.2
28	1000	43	24	49	10	686.2
28	1100	43	34	49	02	1,298.0
28	1115	43	36	49	00	1,308.1
28	1130	43	39	48	59	1,147.7
28	1145	43	41.5	48	59	1,037.8
28	1200	43	43	49	00	824.1
28	1210	43	44	49	00	741.1
28	1215	43	45	49	00	660.8
28	1330	43	45	48	53	1,113.4
28	1400	43	45	48	44	1,264.5
28	1430	43	45	48	37	1,537.6
28	1500	43	45	48	32	1,646.2
28	1600	43	45	48	25	1,697.5
28	1700	43	45	48	09	1,835.5
28	1800	43	45	48	04	1,877.5
28	1900	43	44	47	51	1,972.9
28	2000	43	44	47	39	2,052.0
28	2100	43	41	47	41	2,052.0
28	2200	43	32	47	49	1,899.6
29	0800	42	18	48	49	1,752.5
29	1000	42	09	48	52	1,752.5
29	1200	41	52	48	29	1,873.0
29	1300	41	49	48	24	1,899.6
29	1400	41	40.5	48	11	2,042.0
29	1500	41	31	47	58	2,042.0
29	1600	41	30	47	55	2,094.2
29	1700	41	24	47	47.5	2,121.1
29	1800	41	15	47	35	2,067.7
29	1900	41	06	47	21.5	2,016.7
29	2000	41	04	47	17	2,067.7
29	2100	40	52	47	13	1.949.2
29	2200	40	39	47	09	1,926.3
30	0800	40	41	49	25	2,218.0
30	0900	40	41	49	43	2,159.4
30	1000	40	42	50	02	2,026.5
30	1100	40	44	50	21	1,958.7
30	1200	40	46	50	38	2,057.0
30	1300	40	47	50	56	2,193.8
30	1400	40	48	51	08	2,498.7
30	1500	40	50	51	30	2,748.3
30	1600	40	51	51	44.5	2,802.1
30	1700	40	52	51	55	2,850.0
30	1800	40	54	52	12	1,900.5
30	2000	40	56	52	42	2,753.0
30	2100	40	55	53	05	2,753.0
30	2200	40	56	53	19	2,710.0
July 1	0900	41	15	55	50	2,794.9
1	1000	41	22	56	03.5	2,617.7
1	1100	41	27.5	56	15	2,577.0
1	1200	41	34	56	27.5	2,577.0
1	1300	41	38	56	44	2,577.0
1	1400	41	40	56	57	2,537.0
1	1500	41	42	57	10	2,617.8
1	1600	41	43	57	25	2,577.0
1	1700	41	45	57	40	2,617.8
1	1800	41	47	57	55	2,537.0
1	1900	41	48	58	15	2,537.0
1	2000	41	50	58	30	2,617.8
1	2100	41	52.5	58	45	2,577.0
1	2200	41	54	59	00	2,537.0

ICE OBSERVATION

EDWARD H. SMITH

When the patrol ship, on her first approach to the ice regions, had arrived in the vicinity of the Grand Bank, a request was dispatched to the Canadian Government Radio Station at Cape Race (VAZ) for a summary of the state of the ice up to date. A detailed reply was received giving the position and character of all the ice that had been reported by passing ships, and this is incorporated in the bulletin for this year, heading the list of ice as contained in Table of ice and other obstructions, 1926 (p. 21). The number of bergs south of the forty-eighth parallel is also recorded by months in the table of iceberg anomalies, 1906–1926 (p. 76). The monthly number has been determined by a compilation of all ice reported by passing ships, as well as that sighted by the patrol, care being taken to avoid listing a berg in this area more than once during any one month.

JANUARY

No ice was reported in the western North Atlantic to the best of our knowledge during January. A normal January reports three bergs south of Newfoundland.

FEBRUARY

The first ice report was reported to Cape Race on February 8 (see Table of ice and other obstructions, p. 21), this being slush ice encountered by a ship on the extreme northern part of the Grand Bank near the 100-fathom curve. Eleven other reports were received at various dates throughout the month, all referring to Arctic field ice on the northeastern part of the Bank, except for one report of several small bergs just south of the forty-eighth parallel on February 20. No doubt these were the remains of one or two large bergs, which had survived the summer of 1925, and, being caught in the fields, were naturally the first of the glacial ice to put in an appearance in 1926. It seems reasonable to conclude that only three bergs came south of the forty-eighth parallel during the month of February. Normal conditions would be 12 bergs during February.

MARCH

Thirty-eight reports were received and distributed throughout the month, of ice in the western North Atlantic south of the forty-eighth parallel. Nearly all of these referred to Arctic field ice or to growlers;

only 13 were of the presence of icebergs. Eight of the latter were of bergs classified as large, and one of these was reported three times. The most dangerous bergs reported during the month were a group of four large and three small, reported three different times, as drifting southward more or less together, from the northwestern part of the Bank. The latest report which was probably the direct cause of inaugurating the ice patrol, was contained in the United States Hydrographic Office broadcast of March 20. This dispatch mentioned the positions of four large and three small bergs in the vicinity of

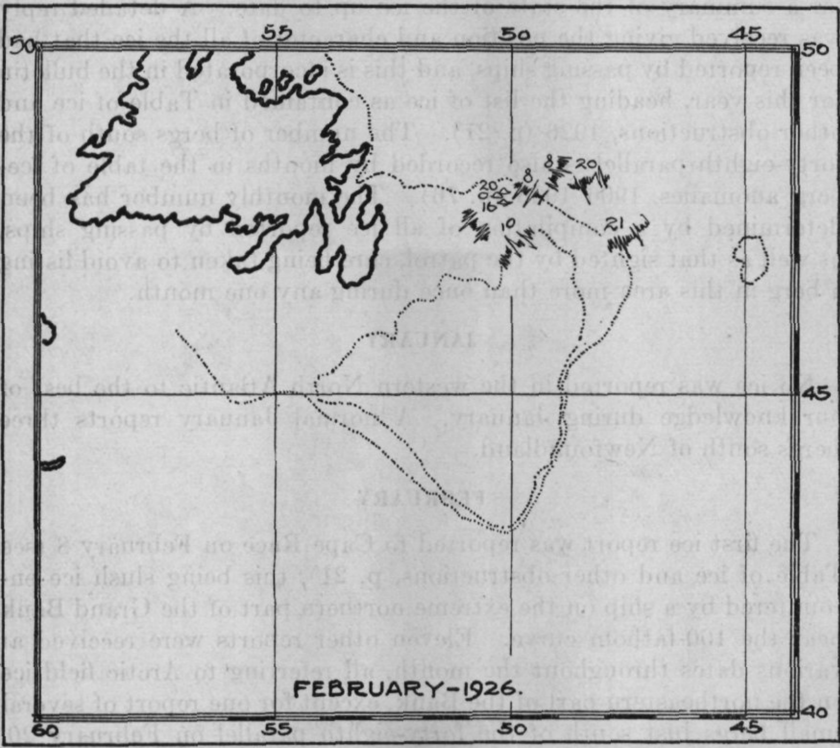

FIG. 10.—February ice map. The position of the first Arctic ice for the season of 1926; the first steamer report from Cape Race was February 8

latitude 45° 15′, longitude 46° 20′. This is about 70 miles offshore of the 100-fathom contour of the Grand Bank, where they might be expected to drift eastward and southward to the northern borders of the Gulf Stream, just where the latter is deflected offshore almost due south of Flemish Cap. No doubt this fate actually befell them as none of these bergs were sighted by the patrol or reported later by passing ships. Probably they finally disintegrated in the warm offshore Atlantic waters, as they drifted northeastward, away from the steamer lanes. Another large berg drifted southward to latitude 45°, about 30 miles seaward of the slope where it was sighted on

March 26. Since no further reports were received, we may conclude that it, too, was caught by the inshore invasion of the warm current and eventually carried offshore to the eastward. It might be added that very few ships frequent the regions where the early season ice is most liable to drift (the patrol at the time is watching the southern end of the field ice), so it is difficult to trace the berg movements in as great detail as is possible a month or two later. Four large bergs were reported on the 27th between the 50 and 100 fathom curves on

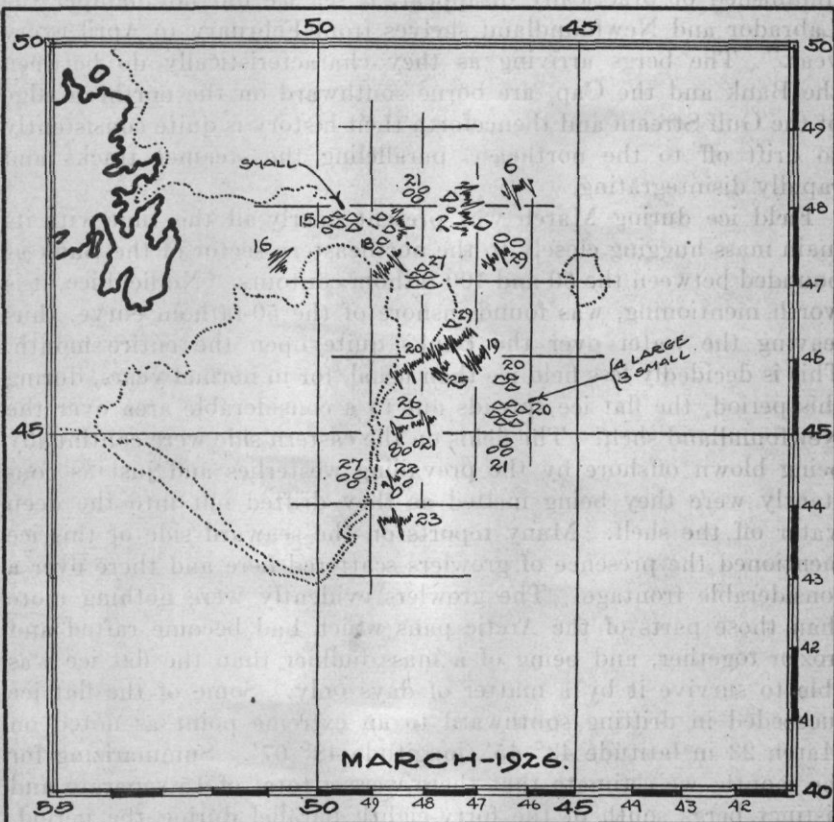

FIG. 11.—March ice map. Position and kind of Arctic ice sighted and reported in the western North Atlantic for March, 1926. ⩘⩘⩘ represents field ice. △ represents an iceberg

the northeastern part of the Bank, this closing the list of bergs reported south of the forty-seventh parallel during the month of March. One of the characteristic drifts of icebergs early in the season (before the early part of April) carries them farther offshore to the eastward than is usual later in the year, as explained in previous annual reports. (See Bulletin No. 12.)

The fact that the first bergs are usually observed relatively far off shore between the Grand Bank and Flemish Cap has been ascribed to the size and extent of the flat ice both as it tends to prevent the bergs from working in shoreward while they are drifting southward past the coasts of Labrador and Newfoundland, and secondly, because of the prevailing westerly gales which in early season exert a tremendous driving force on the fields, within such packs of which the bergs are more or less bound to be caught and deviated. We confidently reiterate a statement made a year or more ago, "The iceberg menace to steamships in the North Atlantic would be greatly diminished or practically disappear, if sea ice did not hamper the Labrador and Newfoundland shelves from February to April every year." The bergs arriving as they characteristically do between the Bank and the Cap, are borne southward on the northern edge of the Gulf Stream and thenceforth their history is quite consistently to drift off to the northeast, paralleling the steamer tracks and rapidly disintegrating.

Field ice during March was present nearly all the time with its main mass hugging closely to the northeastern sector of the Bank as bounded between the 50 and 100 fathom contours. No field ice, it is worth mentioning, was found inshore of the 50-fathom curve, thus leaving the water over the Banks quite open the entire month. This is decidedly less field ice than usual, for in normal years, during this period, the flat ice spreads out to a considerable area over the Newfoundland shelf. The fields on the eastern side were continually being blown offshore by the prevailing westerlies and just as constantly were they being melted as they drifted out into the deep water off the shelf. Many reports on the seaward side of this ice mentioned the presence of growlers scattered here and there over a considerable frontage. The growlers evidently were nothing more than those parts of the Arctic pans which had become rafted and frozen together, and being of a mass bulkier than the flat ice was able to survive it by a matter of days only. Some of the flat ice succeeded in drifting southward to an extreme point as noted on March 23 in latitude 43° 45′, longitude 48° 07′. Summarizing for the month, we estimate that there were a total of 15 separate and distinct bergs south of the forty-eighth parallel during the period, and this is about one-half the number of bergs that usually drift south during the month of March. The field ice was confined to the northern part of the Banks, along the edge of the slope, and driven southward by the winds to the southerly position as noted on the 23d instant. The amount this year is considered below that present in a normal year, but more than prevailed in either 1924 or 1925.

APRIL

The reports for the month of April began to come in on the second day when a berg was sighted by a ship well to the eastward of the

Banks on the inshore edge of the Gulf Stream. This berg was not reported again, and inasmuch as our records for previous seasons indicate quite consistently that ice in such a position drifts northeastward more or less parallel with the steamer tracks, we felt confident such a history occurred in this case. On the 8th three small

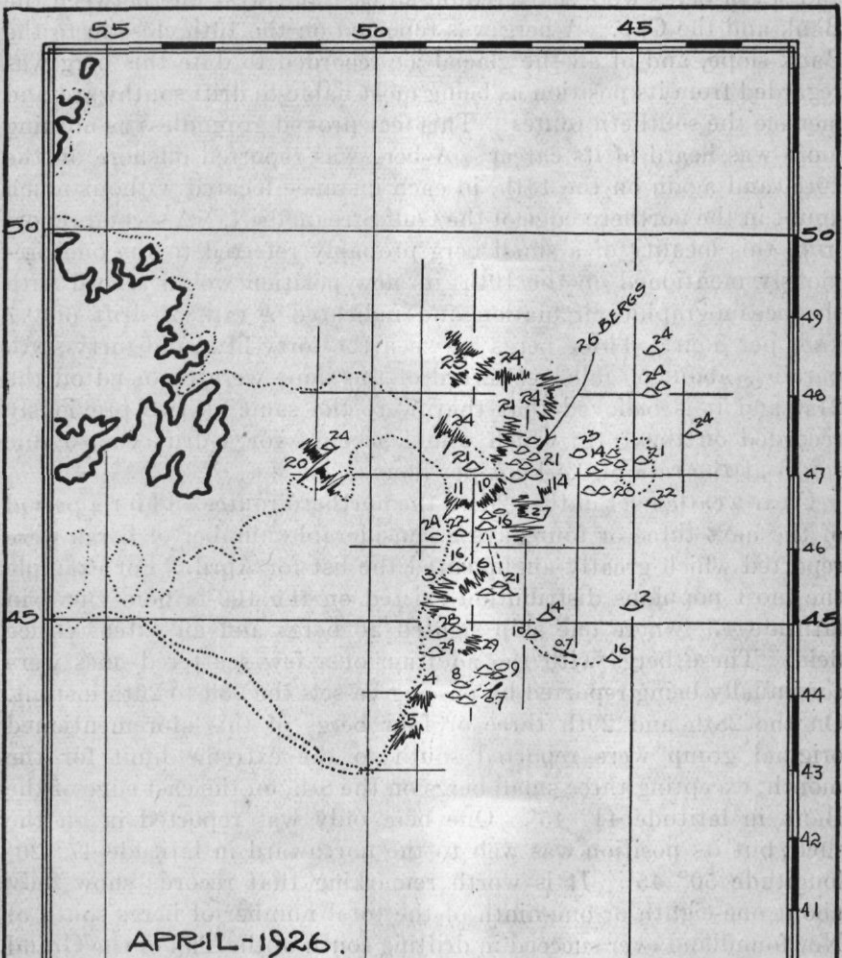

FIG. 12.—April ice map. Position and kind of Arctic ice sighted and reported in the western North Atlantic for April, 1926. [field ice symbol] represents field ice. △ represents an iceberg

bergs were reported on forty-fourth parallel, 40 miles offshore of the continental shelf and the next day the patrol located this group, it having drifted northeastward at the rate of 0.7 knot per hour. The bergs were really so small that they were nearly the size of growlers and it is believed they became entirely melted by the 12th. This position on the forty-fourth parallel, it might be added, was the farthest south recorded for any berg during April. Looking northward on the map for April, we note that four bergs were reported the 14th on the western edge of Flemish Cap. Two bergs were just inside the 100-fathom curve to the westward on the Grand Bank and seven bergs were scattered on an east and west line between the Bank and the Cap. A berg was reported on the 16th close in to the Bank slope, and of all the glacial ice recorded to date this berg was regarded from its position as being most liable to drift southward and menace the southern routes. This fear proved groundless as nothing more was heard of its career. A berg was reported offshore on the 10th, and again on the 14th, in each instance located without much doubt in the northern edge of the Gulf Stream drift. A second report from this locality of a small berg probably referred to the one previously mentioned on the 10th; its new position would accord with the oceanographic circulation and indicated a rate of drift of 0.7 knot per hour. Three bergs between the forty-fifth and forty-sixth parallels about 50 miles eastward of the slope were reported on the 21st and it is believed that they were the same as two previously recorded on the 16th, which would account for a drift almost due south at the rate of 0.4 knot per hour.

Clear weather set in the 22d on the northern routes and for a period of the next three or four days a considerable number of bergs were reported which greatly augumented the list for April. For example the most populous distribution existed on the 100-fathom curve in latitude 47° where one ship sighted 26 bergs and an extensive ice field. These bergs with the addition of a few scattered ones were continually being reported by passing vessels the 23d to 26th instant. On the 28th and 29th three or four bergs of this aforementioned original group were reported south to the extreme limit for the month, excepting three small bergs on the 8th, on the east edge of the Bank in latitude 44° 45′. One berg only was reported in on the shelf, but its position was well to the northward in latitude 47° 20′ longitude 50° 45′. It is worth remarking that records show only about one-eighth or one-ninth of the total number of bergs south of Newfoundland ever succeed in drifting south of the Tail of the Grand Bank.

We ought not to fail to mention the behavior and distribution of the field ice for April. It was present during the entire month on the northeastern slope of the Banks north of the forty-sixth parallel, but due to the fact that there were few ships passing through this zone the presence of the fields were not recorded often. Whenever a ship crossed this vicinity, however, we were quite certain to receive an ice report. The patrol recorded what proved to be the southernmost invasion of the Arctic sea ice for the current year, the field being sighted in the form of an attenuated tongue stretched southward along the edge of the slope to latitude 43° 23′ on April 5. Its movement between the 4th and 5th was at the rate of 1 knot per hour parallel to the slope, while three days after, during the interim of which a westerly gale had prevailed, no vestiges were to be found except an occasional growler here and there well offshore of the slope. On the 29th we received a report from the master of the sealing steamer *Terra Nova* (Captain Kean), containing a general account of field ice conditions northward along the east coast of Newfoundland. He stated having found the main pack about 40 miles north of Funk Island in the early part of March where also were loacted the seals. Northerly winds prevailed, driving the ice into the rivers and bays along the coast, more or less blocking the entire coast line southward to Bonavista Bay. Captain Kean had completed the catch by the 20th and was leaving the western edge of the pack, then about 100 miles east-northeast of Cape Race. The field ice this year, he stated, was much nearer land than last year and there did not appear to be a great quantity of bergs. Field ice was reported off and on pretty nearly throughout the entire month's span and its eastern limits, to the northward, coincided very closely with the forty-seventh meridian. The last few days of the month (the 28th and 29th), field ice emerged again southward to within 80 miles of its farthest southern point described April 5. On April 29 a patch was reported in latitude 44° 30′, longitude 48°.

Summarizing for the month we estimate that there were a total of 58 bergs south of the forty-eighth parallel, the normal number being 78; this is approximately 33 per cent less than the average.

MAY

The reader will recall that during April a group of three bergs had been reported in an extreme southerly position on the east side of the Banks, latitude 44°, on the 8th instant. No bergs had been reported so far south as this throughout the month until the last few days, the 28th and 29th, when a group of three bergs were sighted by a passing steamer between the forty-fourth and forty-fifth parallels in the deep water just off the slope. The first report for the month of May, which indicated that the bergs were on the move to the southward, was that of the 2d instant when a berg was sighted in latitude 44° 10′ on the east side of the Banks. The patrol ship at the time was a few miles southeast, hove to in a northwesterly gale but the position of this berg was regarded with considerable interest as it was the second one for the year, apparently, which was in a critical position to drift southward of the Tail. Accordingly as soon as the gale abated we commenced efforts to locate it and so on from the 3d to 11th instant we carried on a search estimating the probable drift from day to day. The work, however, was greatly handicapped by continual encounters with fog and low visibility which no doubt prevented the patrol from making contact with this iceberg. Throughout this period of eight days reports of bergs to the northward were continually being received and also information regarding the position of isolated fields of ice on the eastern side of the Bank, but none southward of the forty-sixth parallel. Other patches of field ice were reported between

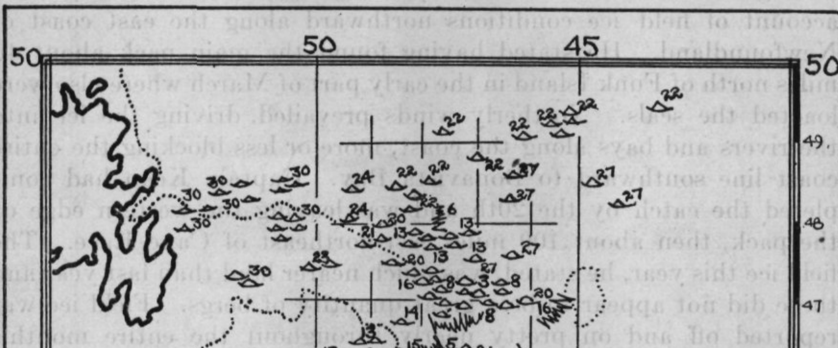

FIG. 13.—May ice map. Position and kind of Arctic ice sighted and reported in the western North Atlantic for the month of May, 1926

the Grand Banks and Flemish Cap. On the 5th, 8th, 9th, and 12th days in May bergs were reported in groups as large as three to five in number all the way from the forty-fifth parallel southward to latitude 43° 30′ just eastward of the edge of the Bank. The reports were not in great detail on account of fog enveloping this entire area, but it was not difficult to observe in general that the bergs were commencing to get farther south and were drifting in their usual path toward the Tail of the Bank. A respite from foggy weather came at last on

May 13 and 14, and these two days of excellent visibility permitted the patrol ship to locate a total of 21 bergs which were scattered along the eastern side of the Bank from the forty-third parallel northward to latitude 44° 15′. This was really the first period of serious scouting

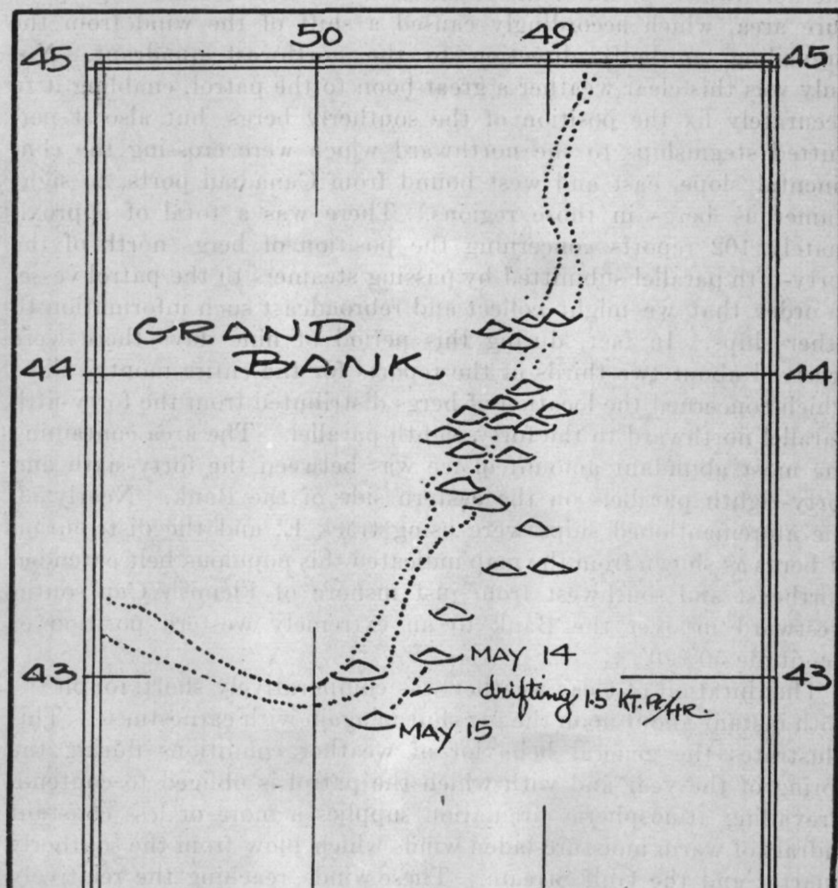

FIG. 14.—Bergs sighted by the patrol May 13-14. These were the vanguard of a greater number than usual which drifted south of the Bank in May

which the patrol had been able to accomplish so far this year and these dates of the 13th and 14th may be accepted quite confidently as marking the initial invasion of glacial ice, during 1926, into relatively low latitudes. Moreover, it was believed that a berg located on the very tip of the Tail of the Bank on both of these dates, was one and the same as reported in a dispatch of the 22d instant and as previously discussed. It remained grounded in this spot; depth of water 43 fathoms, for the next four or five days.

The clearing of the fog on the 13th and 14th instant was due to the northward spread of the summer time North Atlantic high pressure area, which accordingly caused a shift of the wind from the prevailing southerly direction to the northwest quadrant. Not only was this clear weather a great boon to the patrol, enabling it to accurately fix the position of the southerly bergs, but also it permitted steamships to the northward which were crossing the continental slope, east and west bound from Canadian ports, to sight numerous bergs in those regions. There was a total of approximately 102 reports concerning the position of bergs north of the forty-fifth parallel submitted by passing steamers to the patrol vessel in order that we might collect and rebroadcast such information to other ships. In fact, during this period of nine days there were received about two-thirds of the reports for the entire month, all of which concerned the location of bergs distributed from the forty-fifth parallel northward to the forty-eighth parallel. The area containing the most abundant amount of ice was between the forty-sixth and forty-eighth parallels on the eastern side of the Bank. Nearly all the aforementioned ships were using track E, and the distribution of bergs as shown from the map indicated this populous belt extended northeast and southwest from just inshore of Flemish Cap southwestward in over the Bank to an extremely western position of longitude 50° 20′.

The duration of clear weather was comparatively short, for on the 15th instant about noon the fog shut in again with earnestness. This illustrates the general behavior of weather conditions during the spring of the year and with which the patrol is obliged to contend. Prevailing atmospheric circulation supplies a more or less constant indraft of warm moisture-laden winds which blow from the southerly quarter and the Gulf Stream. These winds, reaching the relatively cold water which surrounds the Banks, are cooled and their moisture is precipitated mostly in the form of fog interspersed with rain. Occasional interruptions come in the form of high-pressure atmosphere phenomena which usually bring clear weather for a short time only, so that the patrol has come to expect on the average a period of four to seven days of thick weather followed by two or three days of clear visibility and then a resumption of fog. Before the fog rolled in on the 15th the patrol vessel had time to identify one of the southerly bergs as observed the day previously which was then drifting 1.5 knots per hour southwestward past the Tail. Here then was a potential menace which was probably drifting to the westward, and from the current map probably on to the southwest slope;

but a small deviation in the current might tend to transport this ice offshore, where it was liable to be turned to the eastward and eventually appear in a very unsavory position immediately northward of the steamer lanes. The current map, which had been compiled on board April 29 to May 5 (fig. 49, p. 109), about two weeks previously, indicated, however, that the probable tendency for this ice was inshore to ground on the Bank.

Fog, as we have just remarked left nothing else for us to do but wait patiently near the Tail of the Bank and somewhat to the southward, blind to the movement of the 21 bergs, but hoping any day to get an opportunity for clear weather and another search. The fog continued to prevail for five days, but on the expiration of the third, we decided to remain inactive no longer. It was thought that failing to follow this ice by means of actual contact each day, the next best proposition lay in compiling on board, as soon as possible, a map showing the current in this critical region which was now infested with several bergs. The ice patrol ship, therefore, May 18 to 20, was occupied in making a current survey of these fog-bound waters south and southwest of the Tail—the so-called critical area.

The fog cleared on the 20th instant and also the same day the oceanographic work was completed and the course and velocity of the currents were mapped. As a result of this work is discussed under the section of oceanography it will not be mentioned in detail here except to remark that the Labrador current flowed westward from the Tail to latitude 42° 34′, longitude 51°, and from this point one branch swept westward flooding the slope of the Bank, while offshore a branch bent sharply back 113° through latitude 41° 55′, longitude 50°. A natural inquiry for the reader to make is, "What was the subsequent behavior of the large group of 21 bergs which was located just north of the Tail on May 14?" Since none of this ice was sighted in the critical area southwest of the Tail during the oceanographic survey, it is believed several of the bergs were detained around the slopes of the Bank, and that most of them drifted offshore into the northeast set, with practically no ice following tracks southward past the Tail. It is most likely that the inshore edge of the warm counter current which we have just described on the current map, transported the majority of these bergs northeastward finally to melt them away from the steamer lanes. It is unfortunate that the patrol ship had no opportunity during the month to search this locality in order to corroborate such a belief.

During the period May 15 to 20, reports from ships traversing the regions to the northward were not so numerous as earlier in the month yet it ought to be remembered that these waters were enshrouded in fog as well as where the patrol ship was further south. In spite of the low visibility on the northern routes, however, the bergs continued to be reported, which is pretty good evidence that they must have been quite plentiful, and many of the reports mentioned passing ice close aboard.

Just about nightfall on the 20th of May the steamship *Tiger* reported the position of 10 icebergs to the patrol, on the forty-third parallel, and about 25 miles east of the Tail. The patrol at the time was only a short distance to the southward finishing the last of the oceanographic stations and inasmuch as this ice was in a position from which it was liable to drift farther south the patrol laid plans to locate these bergs the next morning. Fortunately the 21st, 22d, and 23d of May were days of clear weather and this permitted us to determine the position of 26 bergs distributed around the Tail and as far north as 43° 20′. The distribution of this group is shown on the accompanying sketch. There were no large bergs found and it was quite striking to observe that they were all about the same size and fairly well collected together. It is also worth remarking that none of these bergs were identified as any of the former group sighted on the 13th and 14th instant, nor would such a coincidence agree at all with the set and velocity of the currents which had been flowing in this interim of about one week. Several of the bergs were carefully watched as to geographical position and it was quite plainly observed that those farther offshore of the slope were being turned or retarded in the dead water which from the current map existed there. This movement is further illustrated on Figure 15, page 65. A regard of the current map together with the positions of the bergs convinced patrol officials that this ice constituted a serious menace to the present North Atlantic lane routes and it was believed that within the space of 7 to 10 days many of the bergs would be on, or uncomfortably near, the steamship tracks. It was deemed of utmost importance, with such information at hand, to advise Washington immediately to shift the tracks farther south.

Reports regarding the position of bergs to the northward continued to be received by the patrol, and after May 15 the shift from track E to Cape Race track, caused numerous bergs to be sighted in the more northerly latitudes of 48° and 49° and also longitudes farther west, viz, 50° and 51°. (See fig. 13, p. 60.)

The patrol was engaged in effecting the relief between its two ships the 24th and 25th and on the 26th instant, when we had returned to the vicinity of the southern bergs, south of the Tail (see fig. 15, p. 65) a dense fog was encountered. A steamer passing close to us on this day reported having narrowly missed a berg and growler, and a brief light up during the afternoon permitted us to sight what was believed to be the southernmost ice. It was foggy at this time, it must be remembered, and no great area could be searched nor could the bergs be definitely located, so under such conditions there was bound naturally to be a feeling (realizing as we did the direction and velocity of the current), that there was a very good possibility of scattered bergs drifting in widely distant positions. The problem seemed to be without solution, however, as long as fog continued to envelop these waters. Clear weather came on the 27th instant and the patrol was able to get in touch with some of the bergs of the group last plotted in positions May 21 to 23. (See fig. 15.) A group of five bergs were kept in sight for two days, the 27th and 28th instants, and were subsequently reported by passing steamers on

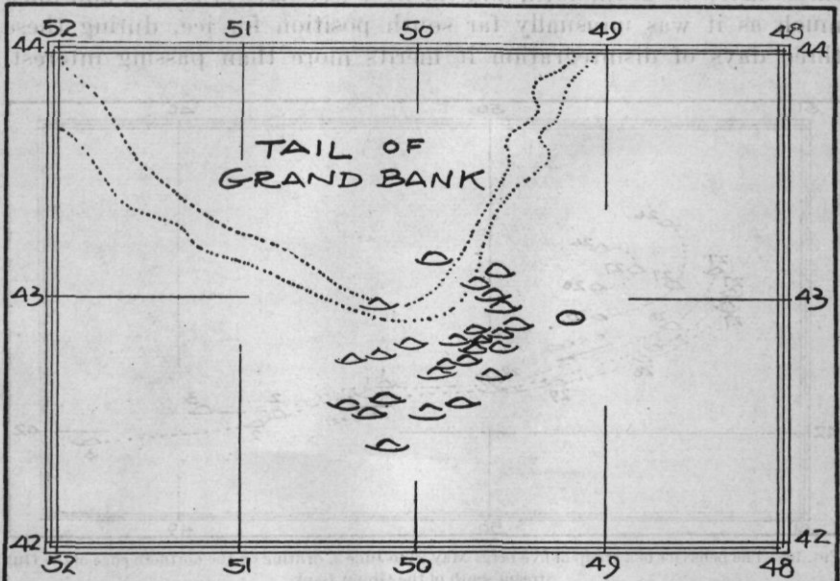

FIG. 15.—Bergs sighted by the patrol May 22 and 23. This was not the same group located May 13-14. (See fig. 14, p. 61.)

May 29, June 1, 2, and 3. Figure 16 is inserted on page 66 in order that the reader may follow the relative positions and career of this ice. The northern bergs of the group were, according to the current map, on the inshore edge of the offshore current but the three southern bergs, that is, those farthest offshore, were in the current proper, drifting 100° at rate of 0.5 knot per hour. This agreed very well with the current as calculated there May 18 to 20, and it showed, furthermore, the manner in which the offshore bergs in the stronger current outdistanced those only a matter of 5 miles or so farther inshore.

Here is an excellent example of the appreciable difference possible in the movement of the water between two places located relatively close together in this critical area south of the Tail. While we were lying near the bergs on the 28th instant observing their behavior, a report of a berg in latitude 41° 50′, longitude 48° 23′ was received and this being only 20 miles north of the westbound track and also the southernmost ice, the patrol immediately headed toward the position at full speed. Twice during the afternoon the same ice was reported by other vessels in about the same position at which we arrived near nightfall. The berg was not very large and was thought to be one of that group originally sighted on May 14 just north of the Tail for its position could under such conditions be attributed to the course and velocity of the current. We followed this berg for three days, the 29th, 30th, and the 31st (see fig. 17, p. 67), and inasmuch as it was unusually far south position for ice, during these three days of disintegration it merits more than passing interest.

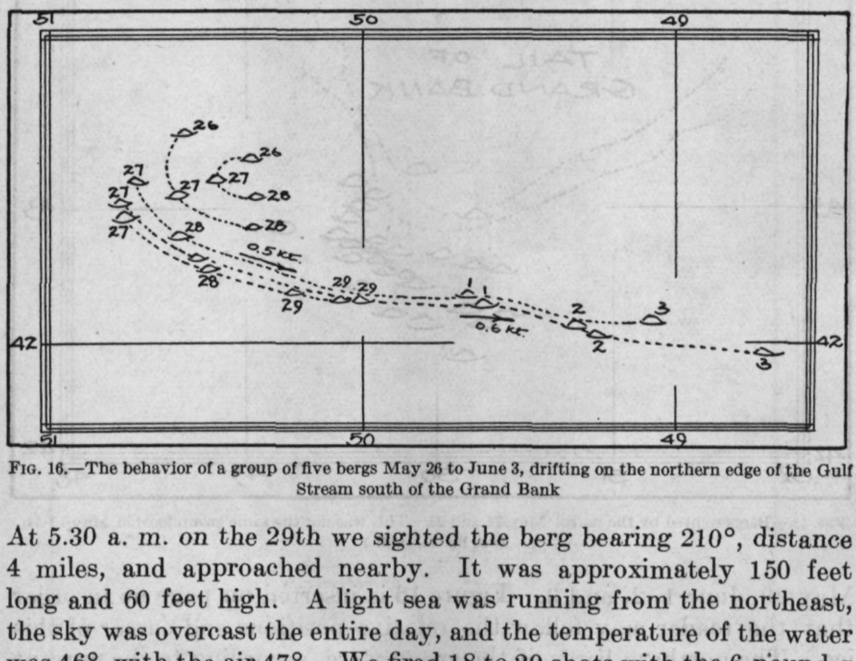

FIG. 16.—The behavior of a group of five bergs May 26 to June 3, drifting on the northern edge of the Gulf Stream south of the Grand Bank

At 5.30 a. m. on the 29th we sighted the berg bearing 210°, distance 4 miles, and approached nearby. It was approximately 150 feet long and 60 feet high. A light sea was running from the northeast, the sky was overcast the entire day, and the temperature of the water was 46°, with the air 47°. We fired 18 to 20 shots with the 6-pounder after gun which brought down considerable ice. In the afternoon two mines containing about 238 pounds of T. N. T. were exploded beneath the surface while suspended by a rope from the berg. The mines tore off several large growlers, but did not cause any great amount of damage. On May 30 during the 4 to 8 a. m. watch a northeasterly swell began to make up which continued quite "lumpy" all day. We came up close to the berg about 2.45 in the afternoon and it was apparent to everyone on board that it had been reduced to one-half its size of yesterday. Many growlers were calving off and the rate of disintegration was rapid. The sea-water temperature did not change from that of the 29th until about 8 o'clock in the afternoon when it rose to 55° as we drifted across the "cold wall." The sky was overcast similar to that of the preceding day. Constant

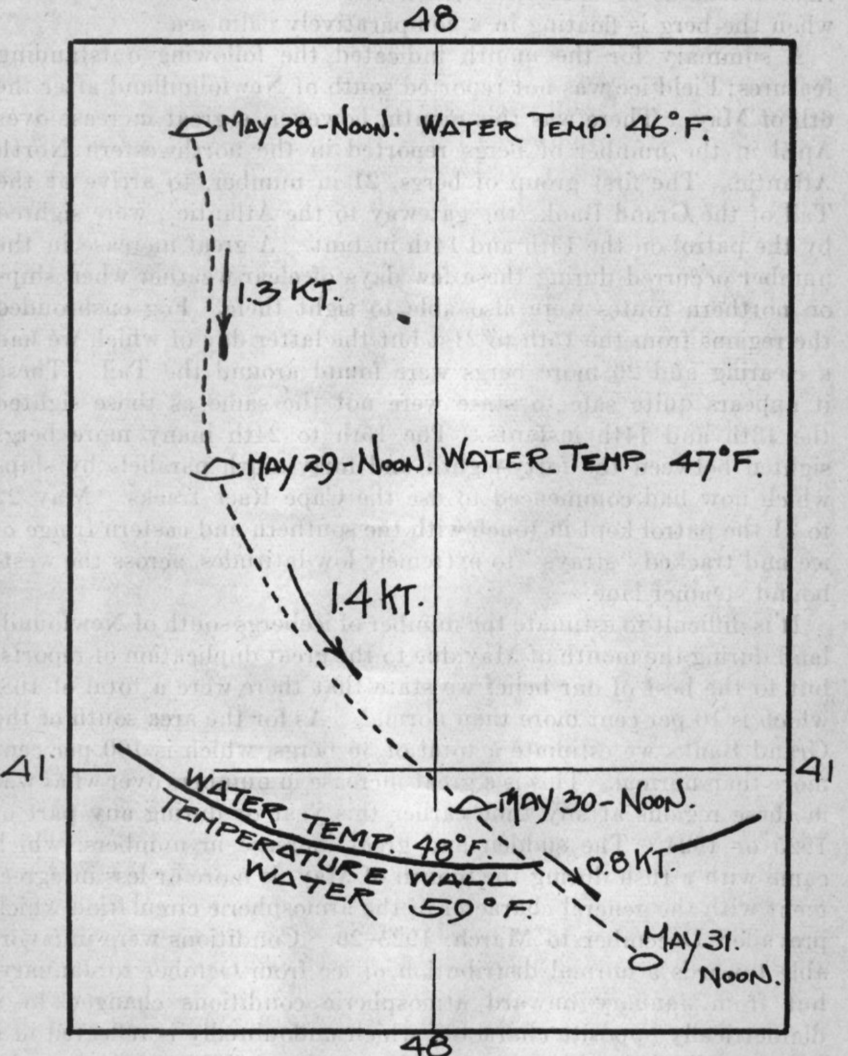

FIG. 17.—The drift and position of final disintegration of a berg followed by the patrol, May 28–31, 1926

touch was kept with the berg during the night and on May 31, at 8 o'clock in the morning, it was no larger than a good size ship's boat. The water temperature had remained constant and the northeast swell continued. The rapid rate of disintegration described herewith is attributable mainly to the appreciable swell and sea which in the

24 hours entirely effaced the berg as a menace to navigation. This is one of the most rapid cases of disintegration of which the patrol has an account and it brings out one fact quite forcibly, namely, that bergs which attain extremely far south drifts such as near the Azores Islands or near the British Isles can only be accomplished when the berg is floating in a comparatively calm sea.

A summary for the month indicated the following outstanding features: Field ice was not reported south of Newfoundland after the 6th of May. There was this month, however, a great increase over April in the number of bergs reported in the northwestern North Atlantic. The first group of bergs, 21 in number, to arrive at the Tail of the Grand Bank (the gateway to the Atlantic), were sighted by the patrol on the 13th and 14th instant. A great increase in the number occurred during these few days of clear weather when ships on northern routes were also able to sight them. Fog enshrouded the regions from the 15th to 21st but the latter day of which we had a clearing and 26 more bergs were found around the Tail. These it appears quite safe to state were not the same as those sighted the 13th and 14th instants. The 15th to 24th many more bergs sighted between the forty-eighth and forty-ninth parallels by ships which now had commenced to use the Cape Race tracks. May 22 to 31 the patrol kept in touch with the southern and eastern fringe of ice and tracked "strays" to extremely low latitudes, across the west-bound steamer lane.

It is difficult to estimate the number of icebergs south of Newfoundland during the month of May due to the great duplication of reports, but to the best of our belief we state that there were a total of 168, which is 10 per cent more than normal. As for the area south of the Grand Banks we estimate a total of 36 bergs, which is 100 per cent more than normal. This is a great increase in numbers over what was in these regions at any time earlier this year or during any part of 1925 or 1924. The sudden and great increase in numbers, which came with a rush during the month of May, is more or less in agreement with the general character of the atmospheric circulation which prevailed December to March, 1925–26. Conditions were unfavorable towards a normal distribution of ice from October to January, but from January onward atmospheric conditions changed to a diametrically opposite character, which undoubtedly is reflected in a correspondingly sudden increase in numbers of bergs around the Grand Banks for May.

JUNE

The preceding month, May, indicated a total of 168 bergs south of Newfoundland, and 36 south of the Tail of the Bank. The latter figure is twice the normal number and consequently the patrol looked forward with no small amount of conviction that an abnormal number of bergs would probably continue during June just northward of the steamer tracks.

The first five days were spent following and standing by two bergs both of which drifted across the westbound tracks between meridians 48 and 49, and consequently formed a distinct menace to steamships during this period.

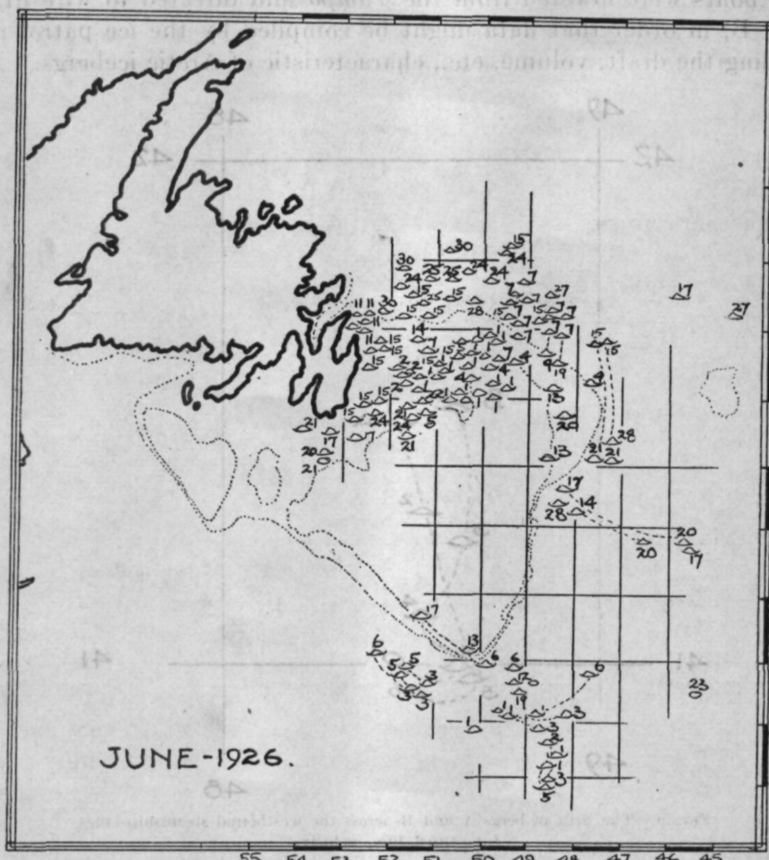

FIG. 18.—June ice map. **Position and kind of Arctic ice sighted and reported in the western North Atlantic for June, 1926**

The sketch shown herewith gives a good idea of the rate and direction of their drift. It is a drift which is noteworthy for the fact that it lies almost at right angles to the general direction of the Gulf Stream (or what we have conceived or believed to be the prevailing direction of flow) in that particular region. Three oceanographic stations taken somewhat to the northward during the period covered, June 1 to 5, indicated no appreciable set, at least in no way commensurate with the drift rate of the ice, viz., 1 to 1.4 knots per hour If we compare the behavior of these two bergs as to their progressive movement southward between the forty-eighth and forty-ninth meridians, with a distribution of icebergs south of Newfoundland 1900–1926 (see fig. 25), we immediately note the tendency of the ice to attain an extremely far south position takes place between these two meridians of longitudes almost without exception. On June 4 two boats were lowered from the *Tampa* and directed to wire drag berg B, in order that data might be compiled by the ice patrol regarding the draft, volume, etc., characteristic of Arctic icebergs. At

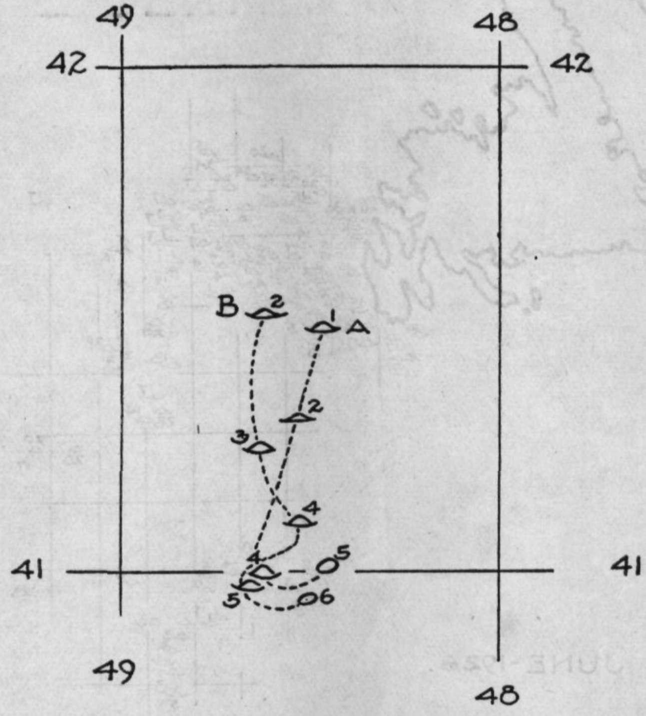

FIG. 19.—The drift of bergs A and B across the westbound steamship lanes June 1 to 6, 1926, inclusive

the same time that the small boats were working on this job measurements as to the exposed surface of the ice were made on the *Tampa* by means of sextant and range finder. The wire dragging operations, unfortunately, were unsuccessful due to the parting of the span which consisted of a condemned sounding machine wire. The above water dimensions were found, however, to be 382 feet long, and an average height above water of 42 feet. This was at 4 p. m. on June 4, latitude 41° 06.5′ north, longitude 48° 27′ west. At 6 p. m. a large square tower on the right-hand side of the berg fell off causing that end to rise, setting up new strains which resulted in cleaving the berg sharply in twain. The face of the cleavage was as flat as if had been carefully planed to such a surface. Naturally, this increased tremendously the rate of disintegration. The temperture of the water and the state of the sea and weather remained quite the same (see p. 36) for the next five days as that recorded on June 4. At 6 p. m. June 5, 24 hours after the disruption described above, the growler formed by the tower sliding into the sea, had entirely disappeared because of melting. The two small bergs formed June 4 were by the 5th a small berg and a growler in size. At 4 a. m. June 6, latitude 40° 56′, longitude 48° 33′, only 10 hours later, every bit of ice had melted. If we had not actually observed this with careful note, we would have been quite skeptical, I am sure. Such an enormous mass of ice such as we measured on June 4 completely disappearing is hard to reconcile with such an extraordinary survival as recorded of a piece of ice June 25 sighted in latitude 30° 20′ north, longitude 62° 32′ west (see U. S. Hydrographic Office Weekly Bulletin for December 8, 1926.)

The ice regions north of the temperature wall on June 4, which had enjoyed clear weather since May 28, were blanketed in fog which prevailed over these waters until June 13, a period of eight days. After remaining near bergs A and B (see fig. 19) until they had completely melted, the natural procedure was to scout and get in touch with other bergs of the group of 26 seen south of the Tail, May 22 and 23. These bergs, being in the colder waters north of the temperature wall, was thought to be in various, but less menacing positions in this region. We attempted scouting but were rebuffed by the fog pall from June 6 to 13. When we did search these waters (the 14th to 17th instant) northward along the east side of the Bank to the forty-fifth parallel no ice was to be found. Passing steamers located a group of three bergs west-southwest of the Tail which from several consecutive reports indicated they were drifting northwest in a branch of the inshore current, up on to the southwest slope of the Bank. A small piece of ice was reported on the 12th and again on the 19th, not far offshore southwest of the Tail in the dead water, and another berg was seen on the tip of the Tail on the 13th and farther northwest on the Bank on the 17th. This was the last report of ice in the region of the Tail for June, so one can appreciate with what suddenness the relatively large group of bergs in positions south of the Tail disappeared from these waters during this month.

Bergs on the northern part of the Bank, on the contrary, continued to be reported with little abatement during the entire month. There were many reports which referred to the same bergs, this fact being quite apparent to anyone charged with keeping a careful check on the total number of bergs. The tendency of drift of these bergs was quite in accordance with what has been observed in previous years, namely, to ground and drag along the bottom and break up on the northern slopes of the Grand Bank. Then as the season grew older, the latter part of the month, an increasing number of bergs were reported in positions along the east coast of Newfoundland, and in the deep-water gully which leads around Cape Race. Such a tendency as described is well shown on Figure 18, as is also the comparatively large number of bergs which collected and stranded on the northern part of the Bank. A report from the steamship *Empress of France* on June 30 indicated a decrease in numbers even here.

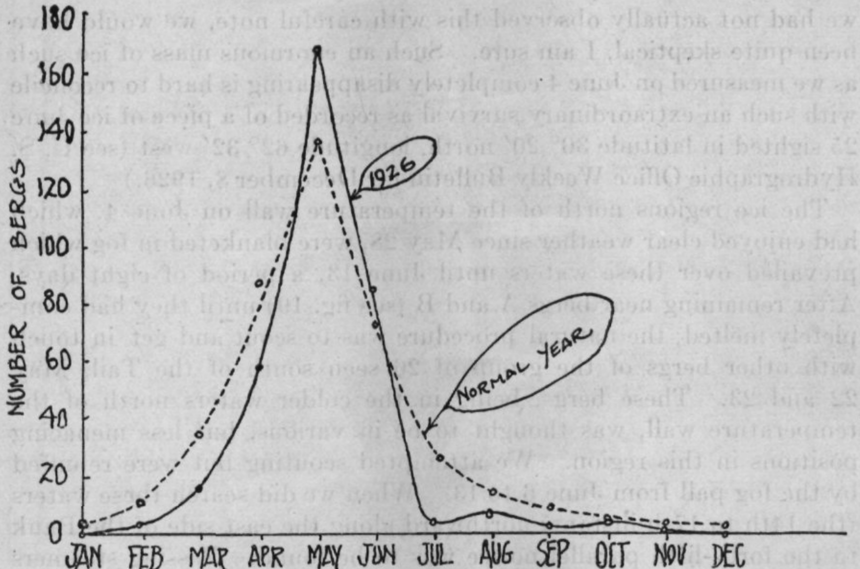

FIG. 20.—Distribution of icebergs south of Newfoundland, 1926. The full black curved line represents the actual distribution, while the dotted line is the normal distribution

The absence of berg reports between parallels 43 and 46 on the eastern side of the Grand Bank was quite noticeable if we but glance at Figure 18. The three or four which were sighted in this locality drifted eastward on the inner edge of the Gulf Stream and did not get south of the Tail. The underlying cause for such a dispersal is contained in a current map especially compiled by the *Tampa* just prior to the discontinuance of the patrol on the 30th instant.

Summarizing, we state that there was a total of 85 bergs south of the forty-eighth parallel, about 10 per cent more than normal, and of this number there were 12 south of the Tail of the Grand Bank, all for the month of June. The most outstanding feature was the rapid decrease in numbers of bergs drifting southward of Newfoundland during June. The waters, after the 17th instant, were entirely free of bergs that could possibly, from currents, and experience of previous years, drift southward and jeopardize trans-Atlantic navigation.

The distribution of icebergs south of Newfoundland by months during 1926 was:

January	0	April	58	July	4	October	3
February	3	May	168	August	6	November	1
March	15	June	85	September	2	December	0

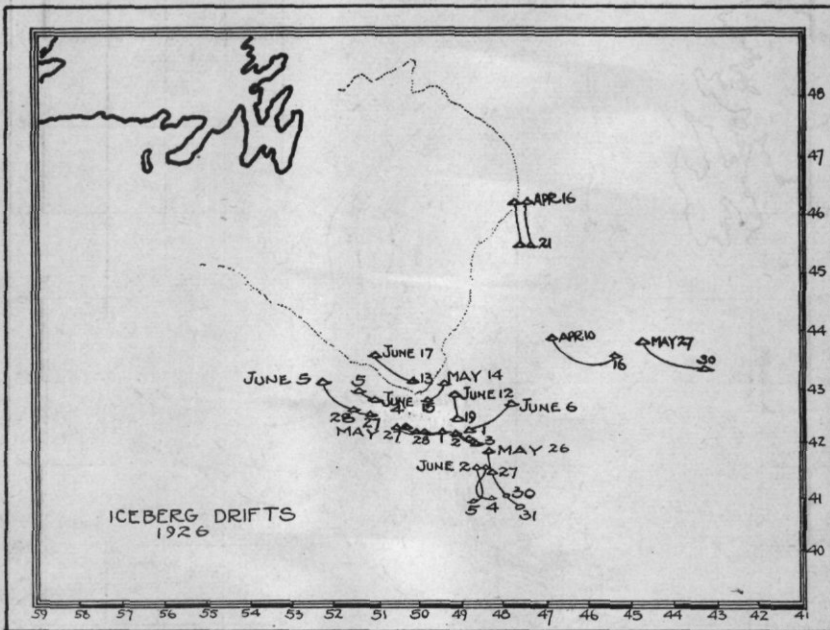

FIG. 21.—Iceberg drifts recorded during the season of 1926

This is shown graphically by a full black line, Figure 20, page 72. The normal distribution is shown as a dotted line.

The bergs that the patrol were able to track in drifts during the ice season are recorded on Figure 21.

A compilation has been made of all the drifts of icebergs around the Grand Bank that the ice patrol has been able to follow, and this chart is shown here.

Fig. 22.—Chart of compiled drifts of icebergs, 1914–1926

SUMMARY OF ICEBERG RECORDS IN THE NORTH-WESTERN NORTH ATLANTIC, 1880-1926

In connection with the ice forecasting work described in the "Weather" section (pp. 31–48) it has been found necessary to collect the very best data from all sources on the amounts of ice from year to year and month to month. For the period 1880 to 1900 advantage was taken of the figures compiled by Mecking and also those of Schott, these investigators having based their comparative estimates of these years on records of the Deutsche Seewarte, the United States Hydrographic Office, the United States Weather Bureau, the United States Signal Service. We made an actual count of the number of icebergs south of Newfoundland by months for the period 1900–1926, and the records consulted in this task were those of the International Ice Patrol, and the United States Hydrographic Office. For the sake of record a table of the actual iceberg count is appended herewith, followed by a table of iceberg anomalies:

NUMBER OF ICEBERGS SOUTH OF NEWFOUNDLAND (48TH PARALLEL) IN WESTERN NORTH ATLANTIC

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1900	10	0	0	5	32	33	6	1	1	1	0	0	89
1901	1	0	0	4	13	29	22	6	5	1	2	5	88
1902	3	0	1	1	13	5	16	1	0	1	0	0	41
1903	0	2	400	166	151	52	23	7	0	0	0	1	802
1904	0	0	12	63	82	89	14	3	2	0	0	0	265
1905	3	2	168	373	109	100	50	9	8	8	0	15	845
1906	14	11	77	49	133	87	18	16	0	0	0	0	405
1907	0	1	11	162	248	138	64	11	0	0	0	3	638
1908	1	0	7	39	82	51	2	2	20	15	3	0	222
1909	0	55	147	134	321	181	121	45	19	1	0	0	1,024
1910	0	0	0	34	10	3	3	0	0	0	0	0	50
1911	0	8	41	112	72	77	21	40	3	0	8	14	396
1912	1	0	34	395	345	159	63	19	0	0	3	0	1,019
1913	2	4	37	109	292	71	14	4	7	0	6	4	550
1914	1	41	32	27	419	71	22	46	52	13	1	6	731
1915	14	72	67	96	97	71	28	17	5	0	1	0	468
1916	0	0	0	0	25	29	0	0	0	0	0	0	54
1917	0	0	13	3	3	9	10	0	0	0	0	0	38
1918	0	0	12	23	26	37	27	34	22	1	14	3	199
1919	3	4	5	25	75	56	26	36	69	2	12	4	317
1920	6	43	20	5	211	86	18	5	18	19	10	4	445
1921	17	5	43	210	198	175	53	24	4	10	1	6	746
1922	0	3	35	71	245	83	21	11	6	27	21	0	523
1923	0	3	28	65	83	42	10	3	2	0	0	0	236
1924	3	0	6	2.	0	0	0	0	0	0	0	0	11
1925	0	3	5	8	58	22	13	0	0	0	0	0	109
1926	0	3	15	58	168	85	4	6	2	3	1	0	345

TABLE OF ICEBERG ANOMALIES

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Normals	3	10	[1] 36	83	130	68	25	13	9	4	3	2	[1] 386
1900	+7	−10	−36	−78	−98	−35	−19	−12	−8	−3	−3	−2	−297
1901	−2	−10	−36	−79	−117	−39	−3	−7	−4	−3	−1	+3	−298
1902	0	−10	−35	−82	−117	−63	−9	−12	−9	−3	−3	−2	−345
1903	−3	−8	+364	+83	+21	−16	−2	−6	−9	−4	−3	−1	+416
1904	−3	−10	−24	−20	−48	+21	−11	−10	−7	−4	−3	−2	−121
1905	0	−8	+132	+290	−21	+32	+25	−4	−1	+4	−3	+13	+459
1906	+11	+1	+41	−34	+3	+19	−7	+3	−9	−4	−3	−2	+19
1907	−3	−9	−25	+79	+118	+70	+39	−2	−9	−4	−3	+1	+252
1908	−2	−10	−29	−44	−48	−17	−23	−11	+11	+11	0	−2	−164
1909	−3	+45	+111	+51	+191	+113	+96	+32	+10	−3	−3	−2	+638
1910	−3	−10	−36	−49	−120	−65	−22	−13	−9	−4	−3	−2	−336
1911	−3	−2	+5	+29	−58	+9	−4	+27	−6	−4	+5	+12	+10
1912	−2	−10	−2	+312	+215	+91	+38	+6	−9	−4	0	−2	+633
1913	−1	−6	+1	+26	+162	+3	−11	−9	−2	−4	+3	+2	+164
1914	−2	+31	−4	−56	+289	+3	−3	+33	+43	+9	−2	+4	+345
1915	+11	+62	+31	+13	−33	+3	+3	+4	−4	−4	−2	−2	+82
1916	−3	−10	−36	−83	−105	−39	−25	−13	−9	−4	−3	−2	−332
1917	−3	−10	−23	−80	−127	−59	−15	−13	−9	−4	−3	−2	−348
1918	−3	−10	−24	−60	−104	−31	+2	+21	+13	−3	+11	+1	−187
1919	0	−6	−31	−58	−55	−12	+1	+23	+60	−2	+9	+2	−69
1920	+3	+33	−16	−78	+81	+18	−7	−8	+9	+15	+7	+2	+59
1921	+14	−5	+7	+127	+68	+107	+28	+11	−5	+6	−2	+4	+360
1922	−3	−7	−1	−12	+115	+15	−4	−2	−3	+23	+18	−2	+137
1923	−3	−7	−8	−18	−47	−26	−15	−10	−7	−4	−3	−2	−150
1924	0	−10	−30	−81	−130	−68	−25	−13	−9	−4	−3	−2	−375
1925	−3	−7	−31	−75	−72	−46	−12	−13	−9	−4	−3	−2	−277
1926	−3	−7	−21	−25	+38	+17	−21	−7	−7	−1	−2	−2	−41

[1] Based on March, 1903, with weight of 150 instead of 400.

The character of the iceberg seasons 1880–1926 is represented by the following table based on a value of 0 to 10:

Year	0	1	2	3	4	5	6	7	8	9
1880	4.7	2.4	6.1	4.7	6.4	7.4	4.0	5.0	4.3	3.5
1890	8.6	3.1	4.0	4.4	6.1	3.0	3.8	6.1	5.1	5.4
1900	3.0	3.0	2.5	7.3	4.1	7.4	4.7	6.4	3.8	8.6
1910	2.8	4.6	8.6	5.7	6.8	5.4	2.8	2.5	3.7	4.2
1920	5.1	6.8	5.9	4.1	2.0	3.3	4.3	------	------	------

This table is represented graphically by Figure 23.

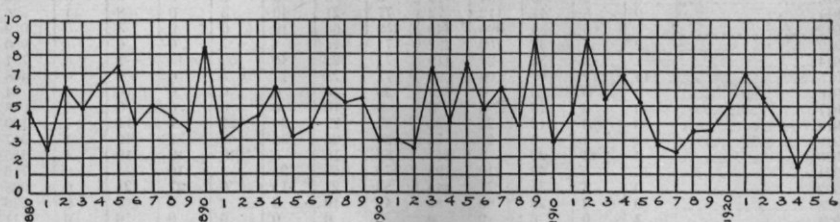

FIG. 23.—The iceberg character of the years 1880–1926, based on a scale 0 to 10. Mean value 4.8

We may now take the iceberg count for the period 1900–1926 and by computing the average of each series of months obtain the normal number of bergs for the western North Atlantic for each one of the 12 months.

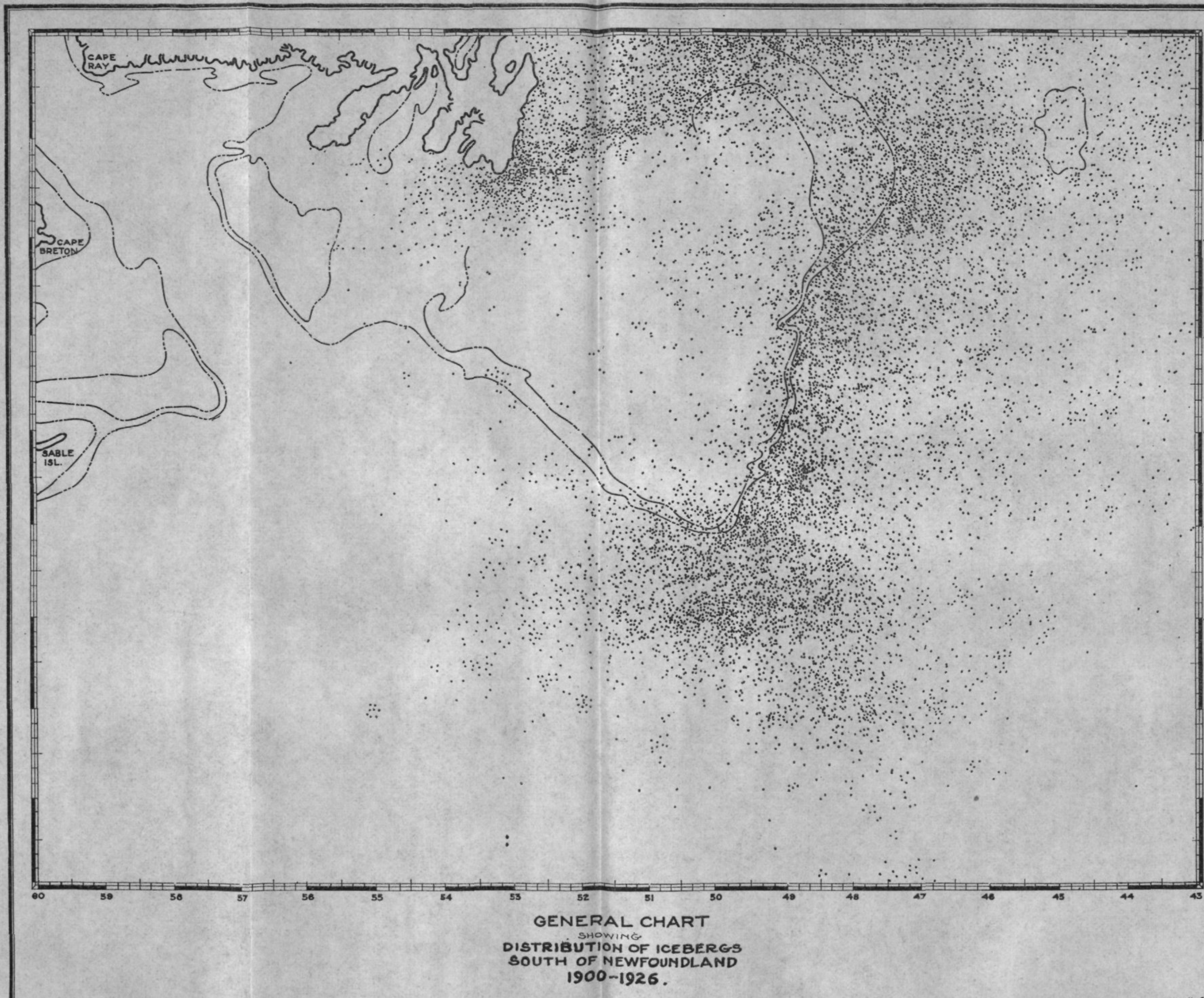

FIG. 25.—Distribution of icebergs south of Newfoundland, 1900-1926, compiled from steamer reports and ice-patrol reports contained in the weekly Hydrographic Bulletins of the United States Hydrographic Office

Normal number of icebergs south of the forty-eighth parallel (menace to the Cape Race tracks)

January	3	April	83	July	25	October	4
February	10	May	130	August	13	November	3
March	36	June	68	September	9	December	2

Normal number of icebergs south of the Grand Bank (menace to the United States to Europe tracks)

January	0	April	9	July	3	October	0
February	1	May	18	August	2	November	0
March	4	June	13	September	1	December	0

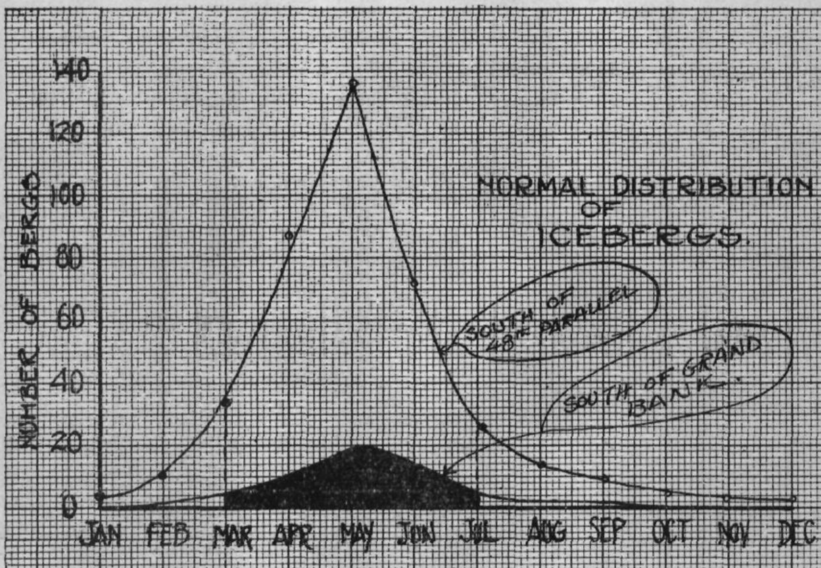

FIG. 24.—The normal monthly distribution of icebergs in the western North Atlantic—(*a*) south of Newfoundland (48th parallel); (*b*) South of the Grand Bank. The black area represents the span of the normal ice season as interpreted by the ice patrol

The monthly distribution throughout a normal year is represented by the two curves on Figure 24. The space between the two dotted vertical lines embraces the normal ice season, March to July. It can be seen from the foregoing that there are really no ice-free months on the Cape Race tracks, while there are only four such months on the United States to Europe tracks.

In the course of the research work which has been carried on by the International Ice Patrol there has been plotted on a chart the position of those icebergs reported by steamships during the period 1900–1926. This material has been taken from the file of United States Hydrographic Office publications, principally the Hydrographic Bulletin.

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δ_t at head of column 9 represents the value, density in situ.
V at head of column 10 represents the value, specific volume in situ.
V–V₁ at head of column 11 represents the value, anomaly of specific volume in situ.
E at head of column 12 represents the value, height in dynamic meters.
E–E₁ at head of column 13 represents the value, anomaly of dynamic height.

Station	Date	Latitude	Longitude	a depth of water	a_1 depth	a=Meters: Temperature	a=Meters: Salinity 0/00	a=Meters: δ_t	a_1=Pressure in decibars: V	a_1=Pressure in decibars: V–V₁	a_1=Pressure in decibars: E	a_1=Pressure in decibars: E–E₁
		° ′	° ′			°C						
554	Mar. 28	42 55	55 50	4,300	0	1.8	33.06	26.45	0.97423	159	0	0
					25	1.4	33.02	26.45	.97423	170	24.35438	.03973
					50	1.2	33.11	26.53	.97392	150	48.70488	.07838
					125	[b]1.4	[b]33.58	26.84	.97331	123	121.72601	.18009
					250	2.8	34.36	27.45	.97218	66	243.31914	.29915
					450	4.2	34.87	27.67	.97110	48	437.65714	.42367
					750	4.1	34.91	27.73	.96973	44	728.78164	.56215
555	Mar. 29	42 47	53 00	4,040	0	2.2	33.46	26.75	.97394	130	0	0
					25	3.3	33.48	26.66	.97392	139	24.34825	.02360
					50	5.2	33.84	26.75	.97371	129	48.69363	.06713
					125	[b]7.2	[b]34.50	27.02	.97315	107	121.70088	.15576
					250	6.3	34.78	27.35	.97229	77	243.29088	.27089
					450	4.9	34.94	27.65	.97112	50	437.63188	.39839
					750	4.1	34.94	27.74	.96972	21	728.75788	.53839
556	do	43 10	52 31	2,550	0	1.0	33.75	27.06	.97365	99	0	0
					25	0.8	33.72	27.05	.97355	102	24.34050	.02585
					50	0.5	33.74	27.08	.97341	99	48.67745	.05095
					125	2.0	34.22	27.37	.97281	79	121.66075	.11563
					250	4.0	34.74	27.60	.97204	42	243.21288	.19289
					450	3.8	34.81	27.68	.97109	37	437.52588	.29239
					750	4.0	34.93	27.76	.96970	41	728.64438	.42489
557	Apr. 8	43 47	50 24	60	0	0.8	32.78	26.29	.97438	174	0	0
					13	0.5	32.78	26.30	.97431	------	12.92305	------
					26	0.3	32.76	26.30	.97426	------	25.58879	------
					39	0.5	32.78	26.30	.97417	------	38.25365	------
					50	------	------	[c]26.30	.97414	172	48.96941	.34291
					52	0.5	32.78	26.30	.97413	------	50.91769	------
558	Apr. 26	42 56	52 59	3,000	0	0.6	33.37	26.78	.97392	128	0	0
					25	0.6	33.39	26.80	.97399	146	24.34638	.03173
					50	0.6	33.69	27.04	.97344	102	48.68676	.06026
					125	2.2	24.31	27.42	.97276	68	121.66926	.12414
					250	2.5	34.58	27.62	.97201	49	243.21739	.19740
					450	3.3	34.78	27.70	.97106	44	437.52439	.29090
					750	3.5	34.88	27.76	.96969	40	728.65189	.43240
559	do	43 14	52 35	1,963	0	2.4	33.17	26.49	.97419	155	0	0
					25	1.8	33.59	26.88	.97371	118	24.34875	.03410
					50	1.0	33.72	27.03	.97345	103	48.68825	.06175
					125	2.4	34.31	27.40	.97278	70	121.68188	.13676
					250	4.0	34.73	27.58	.97215	63	243.22376	.20377
					450	3.3	34.77	27.68	.97108	46	437.53676	.30327
					750	3.6	34.88	27.77	.96968	39	728.65076	.43127
560	do	43 33	52 10	995	0	1.4	33.14	26.54	.97414	150	0	0
					25	1.5	33.17	26.56	.97402	149	24.35200	.03735
					50	0.4	33.22	26.68	.97378	136	48.69950	.07300
					125	−0.6	33.59	27.01	.97314	106	121.70900	.16388
					250	0.4	33.96	27.26	.97235	83	243.30213	.28214
					450	2.2	34.52	27.59	.97116	54	437.65313	.41964
					750	3.1	34.74	27.68	.96977	48	728.79263	.57214
561	Apr. 28	43 01	51 04	784	0	0.0	33.18	26.66	.97403	139	0	0
					25	[b]0.3	33.18	26.67	.97391	138	24.34925	.03460
					50	[b]1.3	33.28	26.79	.97368	126	48.69413	.06763
					125	0.25	33.75	27.10	.97306	98	121.69688	.15176
					250	2.3	34.35	27.44	.97218	66	243.27438	.25439
					450	2.45	34.61	27.64	.97111	49	437.60338	.36989
					750	3.3	34.78	27.69	.96976	47	728.73388	.51439

[b] Differs from observed, having been corrected for smooth curves of temperature, salinity, and density.
[c] Interpolated.

Oceanographic station data and dynamic calculations, 1926—Continued

Station	Date	Latitude	Longitude	*a* depth of water	a_1 depth	*a* = Meters: Temperature	*a* = Meters: Salinity 0/00	*a* = Meters: δ_t	a_1 = Pressure in decibars: V	a_1 = Pressure in decibars: V-V_1	a_1 = Pressure in decibars: E	a_1 = Pressure in decibars: E-E_1
		° ′	° ′			°*C*						
562	Apr. 28	42 41	51 19	2,244	0	3.2	33.47	26.66	.97403	139	0	0
					25	2.8	33.50	26.72	.97386	133	24.34863	.02398
					50	1.3	33.58	26.90	.97357	115	48.69151	.06501
					125	3.6	34.47	27.42	.97276	68	121.74889	.20377
					250	3.9	34.71	27.58	.97205	53	243.29952	.27953
					450	3.85	34.86	27.71	.97105	43	437.60952	.37603
					750	3.5	35.01	27.80	.96965	36	728.71452	.49503
563	do	42 22	51 34	3,322	0	3.0	33.10	26.38	.97430	166	0	0
					25	2.2	33.18	26.51	.97406	143	24.35446	.03981
					50	0.7	33.69	27.02	.97346	94	48.69850	.07200
					125	3.35	34.47	27.44	.97274	66	121.68100	.13588
					250	3.45	34.72	27.63	.97200	48	243.22725	.20726
					450	3.9	34.89	27.72	.97104	42	437.53125	.29776
					750	3.8	34.95	27.78	.96967	38	728.63775	.41826
564	do	42 04	51 48	3,657	0	3.2	33.25	26.48	.97420	156	0	0
					25	0.8	33.73	27.06	.97355	102	24.34688	.03223
					50	1.3	34.07	27.29	.97321	79	48.68138	.05488
					125	2.3	34.45	27.43	.97274	66	121.65451	.10839
					250	4.7	34.93	27.67	.97199	47	243.20014	.18015
					450	4.3	34.95	27.73	.97104	42	437.50314	.26965
					750	3.95	34.96	27.78	.96968	39	728.61114	.39165
565	Apr. 29	41 47	52 02	3,800	0	2.5	33.07	26.42	.97426	152	0	0
					25	5.0	33.69	26.65	.97393	140	24.35338	.03773
					50	4.5	33.90	26.92	.97355	113	48.69588	.06938
					125	7.5	34.63	27.07	.97311	103	121.69563	.15051
					250	7.1	34.91	27.21	.97243	91	243.29188	.27189
					450	[b]6.1	[b]34.92	27.50	.97128	56	437.66288	.42939
					750	4.2	34.94	27.73	.96973	44	728.81438	.59489
566	do	41 06	50 16	3,800	0	16.0	36.17	26.65	.97403	139	0	0
					25	15.7	36.10	26.66	.97391	138	24.34938	.03473
					50	15.0	35.95	26.69	.97378	136	48.69551	.06901
					125	13.2	35.61	26.84	.97333	125	121.81214	.16702
					250	10.9	35.33	27.08	.97258	106	243.33839	.31840
					450	[b]8.5	35.15	27.35	.97145	83	437.74139	.50790
					750	[b]4.6	34.99	27.73	.96975	46	728.95139	.73190
567	do	41 27	50 14	3,860	0	15.4	36.05	26.69	.97400	136	0	0
					25	15.4	36.04	26.69	.97389	136	24.34863	.03398
					50	15.3	36.02	26.70	.97377	135	48.69438	.06788
					125	13.6	35.75	26.86	.97332	124	121.71036	.16524
					250	10.9	35.36	27.10	.97256	104	243.32786	.30787
					450	[b]8.0	35.11	27.38	.97141	79	437.72486	.49137
					750	[b]4.4	[b]34.94	27.72	.96975	46	728.90036	.68087
568	do	41 48	50 13	3,790	0	6.4	33.73	26.52	.97416	152	0	0
					25	6.6	34.18	26.85	.97374	121	24.34875	.03410
					50	11.0	35.23	26.97	.97352	110	48.68950	.06300
					125	9.9	35.03	27.01	.97316	108	121.69375	.14863
					250	6.0	34.44	27.12	.97251	99	243.29813	.27814
					450	4.8	34.78	27.54	.97123	61	437.67213	.43864
					750	[b]3.8	[b]34.90	27.75	.96971	42	728.81313	.59364
569	do	42 08	50 14	3,352	0	3.8	33.16	26.36	.97432	168	0	0
					25	2.7	33.37	26.62	.97396	143	24.35350	.03885
					50	0.9	33.53	26.89	.97358	116	48.69775	.07125
					125	0.7	34.06	27.33	.97283	75	121.68850	.14338
					250	3.5	34.59	27.53	.97211	59	243.24788	.22789
					450	4.0	34.85	27.68	.97109	47	437.56788	.33439
					750	3.6	34.89	27.75	.96971	42	728.68788	.46839
570	do	42 29	50 14	2,560	0	1.2	33.16	26.57	.97412	148	0	0
					25	1.2	33.37	26.74	.97384	131	24.34950	.03485
					50	3.2	33.73	26.87	.97360	118	48.69250	.06600
					125	2.7	34.12	27.22	.97294	86	121.68675	.14163
					250	3.7	34.58	27.51	.97213	61	243.37713	.25714
					450	3.4	34.78	27.69	.97108	46	437.69713	.46464
					750	3.2	[b]34.87	27.77	.96969	40	728.81363	.59914
571	Apr. 30	42 41	49 39	2,194	0	0.4	33.17	26.63	.97406	142	0	0
					25	0.2	33.24	26.70	.97388	135	24.34925	.03460
					50	2.3	33.65	26.89	.97358	116	48.69250	.06600
					125	3.4	34.21	27.23	.97293	85	121.68663	.14151
					250	2.1	34.42	27.52	.97212	60	243.25126	.23127
					450	3.4	34.76	27.67	.97110	48	437.57326	.33977
					750	[b]3.2	[b]34.68	27.76	.96970	41	728.69326	.47377

[b] Differs from observed having been corrected for smooth curves of temperature, salinity, and density.

Oceanographic station data and dynamic calculations, 1926—Continued

Station	Date	Latitude	Longitude	a depth of water	a_1 depth	a=Meters: Temperature	a=Meters: Salinity 0/00	a=Meters: δ_t	a_1=Pressure in decibars: V	a_1=Pressure in decibars: V−V_1	a_1=Pressure in decibars: E	a_1=Pressure in decibars: E−E_1
		° ′	° ′			°C						
572	Apr. 30	42 28	49 22	2,971	0	4.0	33.32	26.47	.97421	157	0	0
					25	3.7	33.72	26.82	.97377	124	24.34975	.03510
					50	2.7	33.76	26.94	.97353	111	48.69100	.06450
					125	3.1	34.13	27.20	.97296	88	121.68288	.13776
					250	3.9	34.64	27.53	.97211	59	243.24976	.22977
					450	4.3	34.88	27.67	.97110	48	437.57076	.33727
					750	[b] 3.5	[b]34.90	27.77	.96969	40	728.68926	.46977
573	do	42 10	48 49	3,291	0	3.4	33.07	26.32	.97435	171	0	0
					25	3.0	33.30	26.54	.97403	150	24.35475	.04010
					50	1.6	33.54	26.85	.97362	120	48.70038	.07388
					125	4.8	34.23	27.11	.97306	98	121.7088	.15576
					250	3.5	34.38	27.36	.97227	75	243.40901	.38902
					450	3.1	[b]34.66	27.62	.97113	51	437.74901	.51552
					750	3.8	[b]34.89	27.75	.96971	42	728.87501	.65552
574	May 1	41 49	48 14	3,657	0	5.0	33.45	26.46	.97422	158	0	0
					25	4.6	33.81	26.80	.97379	126	24.35013	.03548
					50	8.8	34.75	26.97	.97352	110	48.69151	.06501
					125	9.3	34.99	27.08	.97311	103	121.69014	.14502
					250	3.3	34.30	27.33	.97229	77	243.27814	.25815
					450	[b] 3.4	[b]34.67	27.59	.97116	54	437.62314	.38965
					750	4.3	[b]34.91	27.73	.96973	44	728.75664	.53715
575	do	41 28	47 44	3,167	0	14.8	35.94	26.74	.97395	131	0	0
					25	14.6	35.92	26.76	.97383	130	24.34725	.03260
					50	14.4	35.89	26.80	.97368	126	48.69113	.06463
					125	13.3	35.72	26.90	.97327	121	121.70176	.15664
					250	10.7	35.32	27.10	.97256	104	243.31614	.29615
					450	7.1	35.05	27.38	.97140	78	437.71214	.47865
					750	4.7	34.95	27.70	.96978	49	728.88914	.66965
576	do	41 07	47 12	3,230	0	16.7	36.17	26.50	.97418	154	0	0
					25	16.3	36.13	26.52	.97405	152	24.35288	.03823
					50	15.9	36.10	26.62	.97385	143	48.69963	.07313
					125	14.1	35.84	26.83	.97334	126	121.71926	.17414
					250	[b]11.5	[b]35.48	27.07	.97259	107	243.33989	.31990
					450	[b] 8.1	[b]35.11	27.36	.97143	81	437.74189	.50840
					750	[b] 5.0	34.99	27.69	.96979	50	728.92489	.70540
577	May 3	42 57	49 46	760	0	0.0	33.14	26.63	.97406	142	0	0
					25	−0.2	33.14	26.64	.97394	141	24.35000	.03535
					50	−0.1	33.14	26.64	.97382	140	48.69700	.07020
					125	−0.1	33.29	26.76	.97338	130	121.71700	.17188
					250	0.4	33.98	27.28	.97234	82	243.32450	.30451
					450	2.6	34.58	27.60	.97115	53	437.67350	.44001
					750	[b] 3.5	[b]34.79	27.69	.96976	47	728.81000	.59051
578	May 4	43 44	48 58	548	0	0.5	33.23	26.67	.97402	138	0	0
					25	0.4	33.26	26.68	.97390	137	24.34888	.03423
					50	0.2	33.26	26.68	.97388	136	48.69476	.06826
					125	0.6	34.02	27.30	.97287	79	121.69414	.13902
					250	0.9	34.37	27.56	.97207	55	243.25289	.23290
					450	2.45	34.56	27.60	.97115	53	437.77489	.54140
					750	3.25	34.75	27.67	.96977	48	728.91289	.69340
579	May 5	43 43	48 42	2,560	0	2.7	33.50	26.73	.97396	132	0	0
					25	2.7	33.51	26.73	.97385	132	24.34763	.03298
					50	3.0	33.61	26.79	.97368	126	48.69176	.06526
					125	[b] 4.2	[b] 34.35	27.27	.97291	83	121.68889	.14377
					250	5.1	34.89	27.59	.97206	54	243.25577	.23578
					450	4.3	34.86	27.66	.97110	48	437.57177	.33828
					750	3.9	34.89	27.72	.96974	45	728.69777	.47828
580	do	43 40	48 20	3,108	0	3.4	33.52	26.68	.97401	137	0	0
					25	3.0	33.53	26.73	.97385	132	24.34800	.03335
					50	0.3	33.35	26.78	.97369	127	48.69225	.06575
					125	1.15	33.90	27.17	.97300	92	121.69350	.14838
					250	5.35	34.88	27.55	.97210	58	243.26225	.24226
					450	4.7	34.91	27.63	.97113	51	437.58525	.35216
					750	3.8	34.88	27.73	.96973	44	728.71425	.49476
581	do	43 37	48 02	3,657	0	12.2	35.40	26.87	.97383	119	0	0
					25	12.0	35.37	26.88	.97371	118	24.34425	.02960
					50	11.9	35.38	26.92	.97356	114	48.68538	.05888
					125	10.9	35.38	27.10	.97308	100	121.68438	.13926
					250	7.3	[b]34.91	27.32	.97233	81	243.27251	.25252
					450	4.4	34.80	27.60	.97116	54	437.62151	.38802
					750	4.5	34.94	27.70	.96975	46	728.75801	.53852

[b] Differs from observed having been corrected for smooth curves of temperature, salinity, and density.

Oceanographic station data and dynamic calculations, 1926—Continued

Station	Date	Latitude	Longitude	a depth of water	a_1 depth	a = Meters: Temperature	Salinity 0/00	δ_t	a_1 = Pressure in decibars: V	$V-V_1$	E	$E-E_1$
		° ′	° ′			°C						
582	May 6	42 55	49 43	729	0	0.8	33.33	26.73	.97396	132	0	0
					25	0.0	33.34	26.79	.97380	127	24.34700	.03235
					50	-0.2	33.39	26.90	.97357	115	48.68913	.06263
					125	0.7	34.02	27.29	.97289	81	121.68138	.13626
					250	2.6	34.46	27.50	.97214	62	243.24576	.22577
					450	2.7	34.58	27.58	.97117	55	437.57676	.34327
					750	3.3	34.76	27.68	.96976	47	728.61626	.39677
583	May 7	43 50	50 20	58	0	2.4	32.69	26.10	------	------	------	------
					12	2.1	32.71	26.14	------	------	------	------
					24	1.4	32.77	[b]26.20	------	------	------	------
					36	1.4	32.74	26.22	------	------	------	------
					48	1.3	32.82	26.29	------	------	------	------
584	May 14	42 53	49 42	850	0	0.8	35.16	26.61	.97408	114	0	0
					25	-0.4	33.22	26.72	.97386	133	24.34925	.03460
					50	-1.0	34.46	[b]26.80	.97367	125	48.69338	.06688
					125	0.5	33.68	27.03	.97312	104	121.69801	.15289
					250	0.65	34.02	27.30	.97232	80	243.28801	.26802
					450	2.5	34.57	27.61	.97114	52	437.63401	.40052
					750	3.1	34.81	27.72	.96972	43	728.76301	.54352
585	May 18	43 08	51 34	914	0	1.9	32.98	26.38	.97430	166	0	0
					25	-0.2	33.17	26.66	.97392	139	24.35275	.03810
					50	-0.9	33.34	26.82	.97365	123	48.69738	.07088
					125	1.0	34.16	27.39	.97278	70	121.68851	.14339
					250	[b]2.0	34.54	27.62	.97201	49	243.23664	.21665
					450	2.5	[b]34.75	27.74	.97101	39	437.53664	.30315
					750	3.2	34.85	27.78	.96966	37	728.48714	.26765
586	do	42 58	51 50	1,280	0	3.8	33.19	26.39	.97429	165	0	0
					25	3.5	33.21	26.43	.97414	161	24.35528	.04073
					50	2.0	33.53	26.82	.97365	123	48.70276	.07626
					125	3.5	34.27	27.27	.97290	82	121.69839	.15327
					250	3.4	34.58	27.53	.97211	59	243.26152	.24153
					450	3.7	34.84	27.70	.97107	45	437.57952	.34603
					750	3.4	34.90	27.78	.96966	37	728.67402	.45453
587	May 19	42 49	52 05	2,560	0	5.2	33.03	26.11	.97455	191	0	0
					25	4.9	32.99	26.12	.97443	190	24.36225	.04760
					50	3.3	33.21	26.46	.97399	157	48.71750	.09100
					125	2.0	33.91	27.12	.97305	97	121.73150	.18638
					250	3.8	34.51	27.45	.97218	66	243.30838	.28839
					450	3.7	34.73	27.62	.97104	52	437.64038	.40689
					750	4.1	34.92	27.73	.96973	44	728.78088	.56139
588	do	42 30	52 00	2,925	0	5.8	33.14	26.13	.97452	188	0	0
					25	3.0	33.24	26.50	.97407	144	24.35738	.04273
					50	2.6	33.51	26.75	.97371	129	48.70463	.07813
					125	2.8	34.34	27.39	.97279	71	121.69763	.15251
					250	[b]3.8	34.82	27.66	.97199	47	243.35888	.33889
					450	4.1	34.91	27.72	.97105	43	437.66288	.42939
					750	4.2	35.01	27.78	.96968	39	728.77238	.55289
589	do	42 13	51 43	3,500	0	5.8	33.09	26.08	.97458	194	0	0
					25	3.0	33.35	26.58	.97400	147	24.35725	.04250
					50	1.2	33.47	26.82	.97365	123	48.70288	.07638
					125	1.3	33.98	27.22	.97295	87	121.70038	.25526
					250	2.8	34.50	27.52	.97211	59	243.26663	.24664
					450	3.9	34.75	27.62	.97114	52	437.59162	.35813
					750	4.1	34.94	27.75	.96971	42	728.69913	.47964
590	do	42 12	51 11	2,743	0	12.0	34.71	26.38	.97430	166	0	0
					25	12.5	34.81	26.37	.97419	166	24.35613	.04148
					50	14.0	35.78	26.80	.97368	126	48.70451	.07801
					125	[b]10.9	35.44	27.15	.97302	94	121.70614	.16102
					250	[b]6.4	34.84	27.39	.97227	75	243.28739	.26740
					450	[b]4.4	34.85	27.64	.97115	53	437.62939	.39590
					750	[b]4.1	34.94	27.75	.96971	42	728.75839	.53890
591	do	42 33	51 17	2,377	0	6.2	33.38	26.27	.97440	176	0	0
					25	7.9	34.19	26.67	.97391	138	24.35388	.03923
					50	9.3	34.82	26.95	.97353	111	48.69688	.07038
					125	10.0	35.15	27.18	.97300	92	121.69176	.14664
					250	6.7	34.90	27.40	.97225	73	243.26989	.24990
					450	4.6	34.89	27.65	.97112	50	437.60689	.37340
					750	3.9	34.92	27.75	.96971	42	728.73179	.51190

[b] Differs from observed having been corrected for smooth curves of temperature, salinity, and density.

Oceanographic station data and dynamic calculations, 1926—Continued

Station	Date	Latitude	Longitude	*a* depth of water	a_1 depth	*a* = Meters Temperature	Salinity 0/00	δ_t	a_1 = Pressure in decibars V	$V-V_1$	E	$E-E_1$
		° ′	° ′			° *C*						
592	May 19	42 48	51 28	1,645	0	5.3	33.31	26.32	.97435	171	0	0
					25	4.9	33.32	26.37	.97420	157	24.35688	.04223
					50	4.8	34.04	26.95	.97352	110	48.70338	.07688
					125	4.6	34.35	27.23	.97294	86	121.69563	.15051
					250	4.4	[b]34.50	27.37	.97226	74	243.02063	.00064
					450	4.1	34.67	27.53	.97123	61	437.36963	.13614
					750	3.8	34.89	27.74	.96972	43	728.51213	.29264
593	May 20	42 55	51 07	1,463	0	1.6	32.93	26.36	.97432	168	0	0
					25	0.1	32.94	26.46	.97411	158	24.35538	.04073
					50	−0.8	33.21	26.71	.97375	133	48.70363	.07713
					125	0.1	33.71	27.08	.97308	100	121.70976	.16464
					250	1.5	34.15	27.35	.97227	75	243.29414	.27415
					450	[b]2.6	34.53	27.56	.97119	57	437.64016	.40667
					750	3.4	34.84	27.74	.96971	42	728.77514	.55565
594	do	42 45	50 35	1,737	0	2.0	33.08	26.45	.97423	159	0	0
					25	1.4	33.11	26.52	.97405	152	24.35350	.03885
					50	−0.9	33.35	26.82	.97365	123	48.69975	.07325
					125	−0.8	33.64	27.06	.97310	102	121.70288	.15776
					250	2.3	34.11	27.32	.97234	82	243.29288	.27289
					450	2.9	34.57	27.57	.97119	57	437.64588	.41239
					750	3.3	34.84	27.74	.96970	41	728.77938	.55989
595	do	42 23	50 33	2,560	0	2.0	32.92	26.33	.97434	170	0	0
					25	1.8	32.98	26.41	.97416	153	24.35624	.04159
					50	0.4	33.31	26.74	.97372	130	48.69974	.07324
					125	1.8	34.39	27.53	.97266	58	121.68900	.14388
					250	3.4	34.73	27.65	.97198	46	243.22900	.21901
					450	3.6	34.82	27.72	.97104	42	437.53100	.29751
					750	3.6	34.90	27.77	.96968	39	728.63900	.41951
596	do	42 05	50 21	3,340	0	4.6	33.02	26.17	.97450	186	0	0
					25	0.6	33.16	26.60	.97398	145	24.35600	.04135
					50	0.7	33.49	26.87	.97360	118	48.70074	.07424
					125	3.4	34.36	27.34	.97284	76	121.69225	.14713
					250	4.6	34.74	27.53	.97212	60	243.26475	.24476
					450	4.8	34.93	27.66	.97112	50	437.58875	.35526
					750	4.5	35.00	27.75	.96970	41	728.71175	.49226
597	June 2	41 24	48 25	3,160	0	16.7	36.09	26.44	.97424	160	0	0
					25	16.4	36.10	26.52	.97405	152	24.35288	.03823
					50	15.9	36.04	26.59	.97388	146	48.70201	.07551
					125	13.7	35.76	26.85	.97332	124	121.72201	.17689
					250	11.1	35.27	26.99	.97266	114	243.34576	.32577
					450	8.1	34.95	27.24	.97154	92	437.76576	.53227
					750	4.6	34.90	27.65	.96981	52	728.96826	.74877
598	do	41 12	48 39	3,150	0	16.7	36.10	26.45	.97423	159	0	0
					25	16.2	36.08	26.55	.97402	149	24.35300	.03835
					50	15.4	36.04	26.59	.97388	146	48.70175	.07525
					125	13.9	35.82	26.86	.97331	123	121.72138	.17628
					250	11.5	35.38	27.00	.97265	113	243.34388	.32389
					450	7.9	34.89	27.26	.97153	91	437.76188	.52839
					750	4.5	34.87	27.65	.96981	52	728.96288	.74339
599	June 3	41 25	48 45	3,790	0	16.4	36.17	26.57	.97412	148	0	0
					25	16.6	36.13	26.58	.97400	147	24.35150	.03685
					50	15.9	36.08	26.61	.97386	144	48.69975	.07325
					125	13.8	35.80	26.85	.97332	124	121.71900	.17388
					250	12.0	35.48	26.98	.97267	115	243.33713	.31714
					450	8.2	35.04	27.30	.97149	77	437.75313	.51964
					750	5.3	35.00	27.66	.96981	52	728.94813	.72864
600	June 16	42 42	50 18	1,828	0	8.0	32.54	25.35	.97527	263	0	0
					25	7.5	33.65	26.44	.97413	160	24.36750	.05285
					50	5.1	33.48	26.48	.97382	140	48.71688	.09038
					125	1.8	33.82	27.08	.97309	101	121.72602	.18090
					250	2.7	34.03	27.38	.97224	72	243.30917	.28918
					450	5.2	34.68	27.42	.97122	60	437.65517	.42168
					750	4.6	34.95	27.70	.96977	48	728.80367	.58418
601	do	42 32	50 18	2,194	0	9.8	33.88	26.13	.97453	189	0	0
					25	10.2	33.97	26.13	.97442	189	24.36188	.04723
					50	10.6	35.18	26.30	.97415	173	48.71901	.09251
					125	10.75	35.19	27.00	.97317	109	121.74351	.19839
					250	7.8	34.85	27.21	.97239	87	243.34101	.32102
					450	4.9	34.69	27.46	.97131	69	437.71101	.47752
					750	4.3	34.98	27.75	.96971	42	728.86401	.64452

[b] Differs from observed, having been corrected for smooth curves of temperature salinity, and density.

Oceanographic station data and dynamic calculations, 1926—Continued

Station	Date	Latitude	Longitude	a depth of water	a_1 depth	a = Meters: Temperature	a = Meters: Salinity 0/00	a = Meters: δ_t	a_1 = Pressure in decibars: V	a_1 = Pressure in decibars: $V-V_1$	a_1 = Pressure in decibars: E	a_1 = Pressure in decibars: $E-E_1$
		° ′	° ′			°C						
602	June 16	42 22	50 17	2,590	0	10.2	33.26	25.57	.97512	248	0	0
					25	10.5	33.48	25.70	.97483	230	24.37438	.05973
					50	10.8	33.91	25.98	.97446	204	48.74051	.11401
					125	5.3	34.43	27.30	.97297	89	121.76915	.22403
					250	3.5	34.68	27.60	.97211	59	243.33665	.31666
					450	4.1	34.83	27.66	.97111	49	437.65765	.42416
					750	4.5	34.94	27.70	.96975	46	728.78665	.56716
603	do	42 11.5	50 18	2,800	0	9.0	32.94	25.52	.97511	247	0	0
					25	7.9	32.97	25.70	.97483	230	24.37425	.05960
					50	1.5	33.18	26.57	.97389	147	48.73325	.10665
					125	0.8	33.91	27.25	.97291	83	121.73825	.19313
					250	4.4	34.59	27.45	.97208	56	243.30013	.28014
					450	[b]4.5	[b]34.85	27.69	.97108	46	437.61613	.37264
					750	4.1	34.94	27.77	.96970	41	728.73313	.51364
604	June 19	43 50	50 25	62	0	7.7	32.78	25.60	.97504	240	----------	------
					13	6.9	32.81	25.73	------	----	----------	------
					26	6.3	32.81	25.80	------	----	----------	------
					39	1.5	33.07	26.48	------	----	----------	------
					52	1.4	33.08	26.50	------	----	----------	------
605	June 25	42 06	52 50	4,700	0	18.9	36.02	25.85	.97480	216	0	0
					25	18.4	36.03	25.98	.97457	204	24.36712	.05247
					50	17.4	36.04	26.23	.97422	180	48.72700	.10050
					125	17.5	35.80	26.71	.97345	137	121.76380	.21868
					250	[b]11.0	35.50	27.18	.97248	96	243.38190	.36191
					450	[b]7.5	35.20	27.53	.97126	64	437.75590	.52241
					750	4.6	34.84	27.61	.96985	56	728.92240	.70291
606	do	42 25	52 59	4,571	0	17.4	35.68	25.95	.97470	206	0	0
					25	16.6	35.65	26.12	.97443	190	24.36412	.04947
					50	14.2	35.71	26.71	.97376	134	48.71650	.09000
					125	11.8	35.45	27.00	.97318	110	121.72675	.18163
					250	[b]8.9	[b]35.10	27.23	.97242	90	243.32675	.30676
					450	6.0	34.83	27.44	.97133	71	437.70175	.46826
					750	4.4	34.93	27.71	.96976	47	728.86525	.64576
607	June 26	42 43	53 07	4,023	0	11.7	32.98	25.10	.97551	287	0	0
					25	10.5	32.98	25.31	.97520	267	24.38388	.06923
					50	9.6	33.16	25.60	.97482	240	48.75913	.13263
					125	8.0	34.92	27.23	.97295	87	121.80051	.25539
					250	5.8	34.70	27.36	.97228	76	243.37739	.35740
					450	4.0	34.73	27.59	.97117	55	437.72239	.48890
					750	4.0	34.92	27.74	.96972	43	728.85589	.63640
608	do	43 06	52 39	2,560	0	9.1	33.17	25.69	.97495	231	0	0
					25	[b]7.5	33.14	25.90	.97464	211	24.36988	.05523
					50	2.1	33.59	26.86	.97361	119	48.72300	.09650
					125	2.4	34.16	27.29	.97289	81	121.71675	.17163
					250	3.2	34.54	27.52	.97211	59	243.27925	.25926
					450	3.9	34.77	27.63	.97113	51	437.60325	.36976
					750	4.4	34.91	27.69	.96978	49	728.73975	.52026
609	do	43 29	52 09	1,033	0	11.7	34.12	25.98	.97468	204	0	0
					25	9.4	34.09	[c]26.36	.97421	168	24.36112	.04647
					50	4.1	34.07	27.06	.97343	101	48.70662	.08012
					125	[b]3.5	34.33	27.32	.97286	78	121.69250	.14738
					250	3.8	[b]34.54	27.46	.97218	66	243.25750	.23751
					450	4.1	[b]34.65	27.52	.97124	62	437.59950	.36601
					750	3.6	34.75	27.64	.96980	51	728.75550	.53601
610	do	42 56	51 14	1,510	0	12.5	33.81	25.59	.97505	241	0	0
					25	[b]12.3	35.15	26.67	.97391	138	24.36200	.04735
					50	12.0	35.44	26.95	.97354	112	48.70512	.07862
					125	10.4	35.28	27.12	.97306	98	121.70262	.15750
					250	5.9	34.64	27.30	.97234	82	243.29012	.27013
					450	3.6	34.68	27.59	.97117	55	437.64112	.40763
					750	4.4	34.90	27.68	.96979	50	728.78512	.56563
611	do	42 39	51 27	2,304	0	11.4	33.22	25.34	.97528	264	0	0
					25	7.6	33.20	25.94	.97460	207	24.37350	.05885
					50	5.4	34.19	27.01	.97347	105	48.72438	.09788
					125	[b]4.0	34.73	27.31	.97287	79	121.71213	.16701
					250	3.4	34.63	27.57	.97206	54	243.27025	.25026
					450	4.0	34.87	27.70	.97107	45	437.58325	.34976
					750	4.0	34.91	27.72	.96974	45	728.70475	.48526

[b] Differs from observed, having been corrected for smooth curves of temperature, salinity, and density.

Oceanographic station data and dynamic calculations, 1926—Continued

Station	Date	Latitude	Longitude	a depth of water	a_1 depth	a=Meters			a_1=Pressure in decibars			
						Temperature	Salinity 0/00	δ_t	V	$V-V_1$	E	$E-E_1$
		° ′	° ′			°C						
612	June 26	42 20	51 42	2,956	0	11.6	33.16	25.25	.97537	273	0	0
					25	8.9	33.19	25.74	.97479	226	24.37700	.06235
					50	1.7	33.64	26.93	.97354	112	48.73112	.10462
					125	2.0	34.22	27.37	.97281	73	121.71924	.17412
					250	3.4	34.69	27.61	.97202	50	243.27112	.25113
					450	4.0	34.89	27.72	.97105	43	437.57812	.34463
					750	4.0	34.91	27.73	.96973	44	728.69512	.47563
613	do	41 59	51 52	3,660	0	17.0	35.46	25.88	.97477	213	0	0
					25	17.1	35.71	26.05	.97450	197	24.36588	.05123
					50	15.0	35.75	26.58	.97389	147	48.72076	.09426
					125	12.2	[b]35.56	27.01	.97317	109	121.73551	.19039
					250	[b]9.0	35.34	27.41	.97225	73	243.32426	.30427
					450	[b]6.0	35.14	27.685	.97110	48	437.65926	.42577
					750	4.4	35.00	27.76	.96971	42	728.78076	.56127
614	June 27	41 36	52 02	3,860	0	17.4	35.79	26.04	.97462	198	0	0
					25	17.0	35.72	26.08	.97447	194	24.36362	.04897
					50	16.1	35.68	26.27	.97418	176	48.72174	.09524
					125	14.8	35.96	26.77	.97340	132	121.75599	.21087
					250	[b]11.6	35.47	27.05	.97260	108	243.38099	.36100
					450	8.0	34.98	27.28	.97151	89	437.79199	.55850
					750	4.5	34.89	27.67	.96980	51	728.98849	.76900
615	do	41 09	50 20	3,765	0	15.8	35.07	25.86	.97479	215	0	0
					25	[b]15.8	35.21	25.97	.97458	205	24.36712	.05247
					50	15.8	35.63	26.30	.97415	173	48.72624	.09974
					125	13.8	35.76	26.83	.97334	126	121.75712	.21200
					250	11.9	35.46	26.99	.97266	114	243.38212	.36213
					450	8.2	35.07	27.32	.97147	85	437.79512	.56163
					750	[b]4.5	34.99	27.74	.96973	44	728.97512	.75563
616	do	41 32	50 19	3,700	0	18.7	35.79	25.72	.97492	228	0	0
					25	18.4	35.97	25.93	.97461	208	24.36912	.05447
					50	15.5	35.55	26.30	.97415	173	48.72862	.10212
					125	13.2	35.64	26.87	.97330	122	121.75800	.21288
					250	11.0	35.28	27.01	.97264	112	243.37925	.35926
					450	5.3	34.69	27.41	.97135	73	437.77825	.54476
					750	3.3	34.71	27.65	.96980	51	728.95075	.73126
617	do	41 56	50 19	3,430	0	13.6	33.32	25.00	.97561	297	0	0
					25	10.8	33.68	25.80	.97474	221	24.37938	.06473
					50	2.4	33.19	26.51	.97394	152	48.73788	.11138
					125	9.2	35.00	27.10	.97308	100	121.75113	.20601
					250	6.0	34.77	27.39	.97225	73	243.33425	.31426
					450	3.8	34.75	27.63	.97113	51	437.67225	.43876
					750	4.4	35.00	27.76	.96971	42	728.79825	.57876
618	do	42 21	50 18	2,864	0	11.8	33.56	25.55	.97508	244	0	0
					25	9.4	33.67	26.03	.97452	199	24.37000	.05535
					50	4.0	33.92	26.95	.97353	111	48.72062	.09412
					125	4.2	34.41	27.32	.97268	78	121.71024	.16512
					250	4.3	34.74	27.56	.97208	56	243.26899	.24900
					450	4.6	34.95	27.70	.97108	46	437.58499	.35150
					750	4.0	34.93	27.75	.96971	42	728.70349	.48400
619	do	42 46	50 16	1,798	0	12.0	33.96	25.80	.97485	221	0	0
					25	9.8	34.67	26.75	.97383	130	24.35850	.04385
					50	11.5	35.31	26.95	.97353	111	48.70050	.07400
					125	10.1	35.10	27.01	.97316	108	121.70136	.15624
					250	[b]7.0	[b]34.78	27.26	.97239	87	243.29824	.27825
					450	4.3	34.81	27.62	.97114	52	437.65124	.41775
					750	3.4	34.89	27.78	.96967	38	728.77274	.55325
620	June 28	42 51	49 47.5	777	0	9.7	33.38	25.75	.97489	225	0	0
					25	8.5	33.66	26.16	.97440	187	24.36613	.05148
					50	2.4	33.54	26.79	.97368	126	48.71713	.09063
					125	1.9	33.94	27.15	.97302	94	121.71838	.17326
					250	3.4	34.37	27.36	.97226	74	243.42338	.40339
					450	4.4	34.86	27.65	.97111	49	437.76038	.52689
					750	3.8	[b]34.90	27.75	.96971	42	728.88338	.66389
621	do	42 30	49 20	2,560	0	5.7	32.95	25.99	.97467	203	0	0
					25	6.6	33.94	26.66	.97392	139	24.35738	.04273
					50	11.2	35.29	26.99	.97350	108	48.70013	.07363
					125	7.9	34.82	27.17	.97301	93	121.69426	.14914
					250	5.3	34.52	27.28	.97236	84	243.27989	.25990
					450	[b]3.9	34.64	27.53	.97123	61	437.63889	.40540
					750	4.2	34.82	27.65	.96980	51	728.79339	.57390

[b] Differs from observed, having been corrected for smooth curves of temperature, salinity, and density.

Oceanographic station data and dynamic calculations, 1926—Continued

Station	Date	Latitude	Longitude	a depth of water	a₁ depth	Temperature (a=Meters)	Salinity 0/00	δ_t	V (a₁=Pressure in decibars)	V-V₁	E	E-E₁
		° ′	° ′			°C						
622	June 28	43 45	49 00	1,060	0	5.6	32.87	25.95	.97470	206	0	0
					25	4.6	32.88	26.06	.97449	196	24.36488	.05023
					50	1.1	33.13	26.55	.97391	149	48.71988	.09338
					125	0.6	33.73	27.08	.97308	100	121.73200	.18688
					250	1.7	34.28	27.44	.97218	66	243.31075	.29076
					450	3.0	34.72	27.68	.97108	46	437.63675	.40326
					750	[b]3.7	34.87	27.74	.96971	42	728.75525	.53576
623	do	43 45	48 33	2,590	0	9.0	32.92	25.50	.97513	249	0	0
					25	7.1	33.03	25.87	.97467	214	24.37250	.05785
					50	1.7	33.85	27.10	.97339	97	48.72325	.09675
					125	2.4	34.48	27.52	.97267	59	121.70050	.15538
					250	[b]4.5	34.90	27.67	.97198	46	243.24112	.22113
					450	4.0	34.92	27.75	.97102	40	437.54112	.30763
					750	3.7	34.92	27.78	.96967	38	728.64462	.42513
624	do	43 45	48 04	3,125	0	8.2	32.98	25.68	.97496	232	0	0
					25	4.9	33.36	26.41	.97416	163	24.36400	.04935
					50	2.3	34.06	27.22	.97327	85	48.70688	.08038
					125	3.8	34.59	27.50	.97269	61	121.68038	.13526
					250	4.2	34.86	27.67	.97198	46	243.22226	.20227
					450	4.3	34.98	27.76	.97101	39	437.52126	.28777
					750	3.8	34.96	27.80	.96965	36	728.62026	.40077
625	do	43 45	47 40	3,590	0	13.8	33.87	25.38	.97525	261	0	0
					25	13.7	34.17	25.63	.97490	237	24.37688	.06223
					50	13.3	34.47	25.94	.97449	207	48.74426	.11776
					125	9.4	35.00	27.07	.97311	103	121.77926	.23414
					250	5.4	34.62	27.35	.97229	77	243.36676	.34677
					450	4.4	34.84	27.64	.97113	51	437.70876	.47527
					750	4.0	34.94	27.76	.96970	41	728.83326	.61377
626	June 29	42 10	48 54	3,200	0	11.4	34.40	26.25	.97442	178	0	0
					25	11.4	34.49	26.33	.97423	170	24.35813	.04348
					50	10.7	35.22	27.02	.97347	105	48.70438	.07788
					125	8.1	34.86	27.17	.97301	93	121.69738	.15226
					250	4.8	34.67	27.45	.97219	67	243.27238	.25239
					450	4.8	34.92	27.65	.97112	50	437.60338	.36989
					750	3.7	34.85	27.72	.96974	45	728.73088	.51139
627	do	41 50	48 25	3,660	0	11.1	33.28	25.43	.97520	256	0	0
					25	7.7	33.11	25.85	.97469	216	24.37363	.05898
					50	5.5	33.84	26.72	.97375	133	48.72913	.01263
					125	4.8	34.56	27.36	.97283	75	121.72588	.18076
					250	3.9	34.71	27.59	.97205	53	243.28088	.26087
					450	3.9	34.85	27.70	.97107	45	437.59288	.35939
					750	3.9	34.92	27.75	.96971	42	728.70988	.49039
628	do	41 30	47 55	3,175	0	15.4	34.17	25.26	.97536	272	0	0
					25	14.9	34.77	25.83	.97471	218	24.37588	.06123
					50	9.0	34.50	26.75	.97372	130	48.73126	.10476
					125	10.9	35.31	27.05	.97312	104	121.73776	.19264
					250	6.8	34.83	27.33	.97232	80	243.32776	.30777
					450	[b]4.8	[b]34.75	27.57	.97120	58	437.67976	.44627
					750	4.4	34.97	27.73	.96974	45	728.82076	.60127
629	do	41 04	47 17	3,245	0	16.6	35.28	25.84	.97481	217	0	0
					25	16.3	35.54	26.11	.97444	191	24.36563	.05098
					50	15.9	36.09	26.62	.97385	143	48.71926	.09276
					125	14.6	35.95	26.81	.97336	128	121.73971	.19459
					250	11.6	35.36	26.96	.97271	119	243.36911	.34912
					450	7.0	35.03	27.46	.97133	71	437.77311	.53962
					750	4.9	34.96	27.67	.96981	52	728.94411	.72462
630	*do*	*40 39*	*47 08*	*3,840*	*0*	*14.5*	33.96	25.30	.97532	268	*0*	*0*
					25	15.1	34.92	25.91	.97463	210	24.37438	.05973
					50	14.0	35.62	26.68	.97379	137	48.72963	.10313
					125	13.3	35.70	26.89	.97328	120	121.74475	.19963
					250	11.2	35.37	27.05	.97260	108	243.36225	.34226
					450	8.2	*35.15*	27.38	.97141	79	437.76325	.52976
					750	5.2	35.04	27.70	.96978	49	728.94175	.72226

[b] Differs from observed, having been corrected for smooth curves of temperature, salinity, and density.

OCEANOGRAPHY

Edward H. Smith

It ought to be emphasized that the London convention which gave genesis to the idea of an ice patrol also laid particular stress upon the importance of collecting scientific data. It was believed that the patrol could give the most efficient economic service to shipping only when scientific methods were employed to support the practical work. Oceanographical investigations of the waters of the ice regions have, during the past 13 years of the service, gradually come to be recognized as contributing a clear and accurate insight into the behavior of floating ice. Such information is not only important for the patrol, but it likewise means greater safety for lives and ships on the North Atlantic. It is obvious that observations restricted solely to the surface do not furnish a true and complete picture of the circulation which is in process, and it is only by including the subsurface that we can hope to obtain a correct view of the interaction between the water masses as a whole.

The oceanographic information of which the patrol makes a complete analysis in arriving at conclusions regarding the behavior of ice, consists of the following:

(*a*) Vertical distribution of salinity, temperature, and density.

(*b*) Horizontal distribution of salinity, temperature, and density.

(*c*) Horizontal distribution of potential (current maps).

Ice scouting is the primary work of the patrol, and this means limiting the number of stations to the minimum and confining the observations to depths no greater than are essential for obtaining the true picture of the circulation. It is also necessary to remember that the more nearly simultaneous the observations can be, the more accurate picture is for the area covered. An ideal program, of course, includes a maximum number of stations distributed netlike over the area investigated and along lines running at right angles to the currents. Therefore, before commencing the observational work all available data as to the hydrographical nature of the ice regions should be carefully studied. This matter received the attention of the Interdepartmental Board on Ice Patrol as early as 1921, when a tentative program was formulated, which has been carried out more or less intensively ever since. The program was revised slightly in 1926 and is described here in some detail, because observations ought to be patterned along the same general lines for several years to come. A standardized program permits ready comparisons between a series of years.

GENERAL PROGRAM OF WORK

The oceanographic plan is based on five lines of stations which run more or less at right angles to the currents and to the general trend of the Grand Bank slopes along the following radials:

Line A: Length 60 miles, 3 stations.
Line B: Length 88 miles, 5 stations.
Line C: Length 100 miles, 5 stations.
Line D: Length 180 miles, 7 stations.
Line E: Length 60 miles, 4 stations.

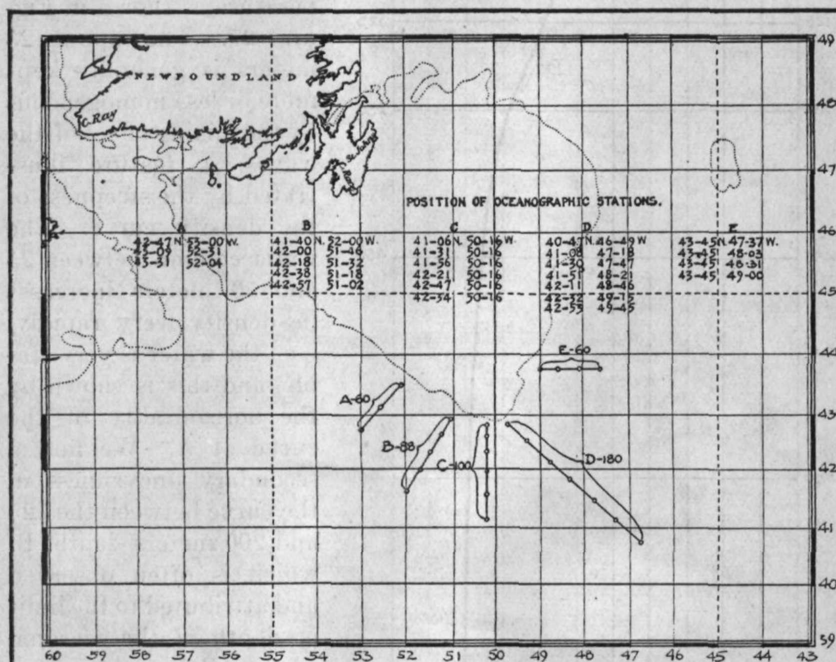


FIG. 26.—The selected position of stations upon which are based the oceanographic surveys conducted by the ice patrol

This distribution of stations permits a vertical examination of the water mass to be extended offshore from five different points along the slope of the Grand Bank, and it also allows us to determine the important physical variations taking place in the ice-infested waters. The distance between stations is set at 20 to 30 miles in order that all the principal features will be detected, and the stations are extended offshore from the Newfoundland shelf for a distance of 60 to 180 miles. The innermost stations are placed as far in on the continental slope as possible, and yet readings secured from the standard maximum depth of observation, 750 meters, without the weights touching bottom. It is important to take temperature and salinity observations from a sufficient number of levels of depth in order that the change in physical character of the water may be followed in detail. It is equally important that observations be extended downward to abyssal regions where uniformity of conditions tend to prevail. The greatest changes per unit increase in depth in an ocean are generally in the surface layers, and the deeper we penetrate the more homogeneous becomes the mass. A characteristic graph of the density which is based on the two fundamentals, salinity and temperature, is shown in Figure 27. The upper 25 meters is generally kept more or less homogeneous by the mixing effect of the waves, a feature illustrated by the steepness of the density curve. The water column between 25 and 50 meters increases in density very rapidly, i. e., the water is very stable, and this is shown by the horizontality of the curve at A. We find a secondary unevenness in the curve between the 125 and 200 meters depth, B, which is often observed and attributed to the limit of depth of the seasonal effect. Below this point the curve gradually and constantly approaches a straight line as homogeneous abyssal water is entered. In accordance with this normal stratification, the ice patrol has adopted a minimum number of standard depths at which the observations for salinity and temperature are always taken, viz., 0, 25, 50, 125, 250, 450, and 750 meters. It has been found, however, that considerable circulation takes place even below 750 meters, if we proceed as far 120 miles offshore from the continental edge. Therefore it would seem desirable in future years to extend the observations at least to 1,200 meters.

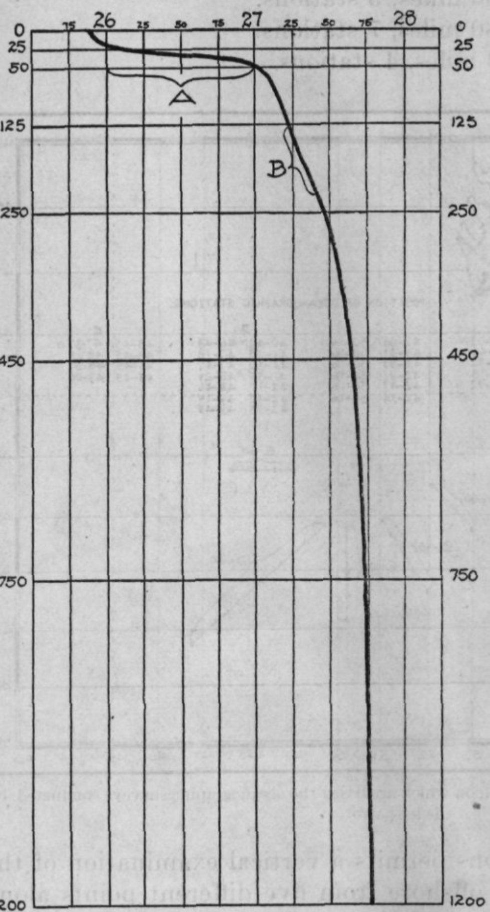


FIG. 27.—An example of the distribution of density with ocean depth

HOW TO AVOID ERRORS IN OBSERVATIONS

It is very easy for one not thoroughly schooled in the art of collecting observations of the temperature and salinity of a water column to make all sorts of errors. Usually the mistake is not detected until some later date when, alas, it is too late to repeat observations and rectify the error. It behooves observers to exercise the greatest care in order that the degree of accuracy be raised as high as possible, and the reputation of the records correspondingly enhanced. The following hints may be found useful by future investigators:

(1) The water bottles should be in the finest working condition, and should be gone over and oiled frequently.

(2) Guard carefully against a tendency for the bottle to close prematurely.

(3) Each bottle should be equipped with two thermometers.

(4) Thermometers should be functioning properly and kept under close observation.

(5) If thermometers in the same bottle do not check, they should be examined.

(6) The mercury column should be continuous from the bulb end when the bottles are lowered over the side.

(7) The meter wheel should be checked occasionally for accuracy of measurement.

(8) The wire should be guarded against kinks.

(9) The wire should be oiled occasionally.

(10) The wire should be vertical when the top messenger is released.

(11) Never take station observations if wire has a slant of more than 35° with the sea surface.

(12) Allow five minutes after lowering the instruments before releasing the first messenger.

(13) Determine time interval for bottom bottle to be tripped at various depths and do not start hoisting until this interval has expired.

(14) Do not capsize bottles when removing them from wire.

(15) Read thermometers with great care and note registration in record book.

(16) Each bottle should then be returned to its properly marked stall in the rack in order of sequence.

(17) When last bottle is being hoisted on board, or before, plot the temperature readings of the various depths of observation on cross-section paper. If the values do not form a smooth curve characteristic for the time and place, repeat suspicious observations immediately before leaving station. Ability to detect errors in temperature curves comes with experience.

(18) Citrate bottles should be clearly marked to indicate the station number and the particular depth from which filled.

(19) Stoppers on citrate bottles should be absolutely air-tight.

(20) Coach oceanographic party in teamwork.

(21) Determine salinity of water samples by running them through the electric salinity tester on board and in accordance with instructions for same.

(22) Test salinity values on cross section for smooth curve.

(23) Apply to stem temperature of deep-sea thermometers the proper correction for auxiliary thermometer reading.

(24) Obtain density values by entering temperature and salinity graph.

(25) Test densities for smooth curve on cross-section paper. (See fig. 27, p. 88.)

A PROBLEM THAT HANDICAPS THE ICE PATROL

One of the most important natural problems which has confronted the ice patrol has been the securing of advance information regarding the probable drift of ice after arrival at the gateway to the Atlantic (the vicinity of the Tail of the Grand Bank). If we glance at a general map of the northwestern North Atlantic we may trace the general course followed both by the current and by the ice stream southwards along the continental slope from Baffin Land to the Tail of the Grand Bank without great change in direction for a distance of 1,800 miles. But when the cold Arctic water is discharged past the Tail of the Bank it is no longer preserved by the general trend of the continental slope, but is forced to meet directly the easterly moving masses of, or associated with, the Gulf Stream. It is at this point that the course of the current, and likewise its freight of ice, is subjected to great variations in direction. Naturally it is extremely desirable for the patrol to be able to disseminate to shipping, whether the ice will be deflected northward again into the shallow shelf waters, or whether it will be swept southward across the North Atlantic Lane Routes, and so create a very grave menace to shipping. If the patrol had knowledge of the drift tracks which bergs would follow after arrival at the gateway to the Atlantic, much more detailed information could be furnished to approaching vessels, especially during the protracted periods when fog enshrouds this cold-water region.

NEW METHODS IN OCEANOGRAPHY INTRODUCED ON ICE PATROL

The interdepartmental board charged with the administration of ice patrol had for some time been following the modern methods pursued in oceanography, particularly those taught at the Geophysical Institute, Bergen, Norway. The board believed that these methods had a practical application to the ice patrol's unique problem, as described in the preceding paragraph. The new thought in this branch of oceanography was more or less widely introduced by Prof. V. Bjerknes and others [1] in a treatise on the dynamics. Since that time several Scandinavian oceanographers have attained such success in further applying Bjerknes' basic formula to oceanographic investigations that arrangements were made for me to attend the Geophysical Institute, Bergen, 1924–25, for a year's study with Prof. Helland-Hansen on the theory of free motion and for instruction in the various methods of illustration. The oceanographic records of the ice patrol, some 3,000 observations of temperature and salinity from various depths and places in the ice regions, were also treated at the Geophysical Institute by mathematical computation. It is hoped to have this research published. The first maps thus ever

[1] Dynamic Meteorology and Hydrography. Carnegie Inst. Pub., Washington, 1910–11.

drawn of the circulation in the ice regions indicate a close agreement between the calculated currents (velocity and direction) and the actual drifts of bergs at the time and place. Dynamic oceanography provides an easy and efficient means for mapping currents over extensive ocean surfaces, which guarantees it wide employment in future hydrographical surveys. If properly employed on ice patrol, moreover, it promises some day to vindicate the belief of the members of the London Convention which established the ice patrol, viz.:

> Skilled navigators and scientists are confident, partly as a result of Arctic and Anarctic explorations of recent years, that a thorough study and observation of ice conditions and formation, and of the Labrador current and other currents, the natural laws governing the formation and the movements of ice in the North Atlantic may be determined, at least to the extent of permitting approximate forecasts, similar to recent meteorological forecasts, which will contribute to safer ocean navigation.

If we steam the patrol vessel over the critical ice area, taking observations of the salinity and temperature at selected places, the data thus collected furnish the material for calculating the direction and velocity of the currents.[2]

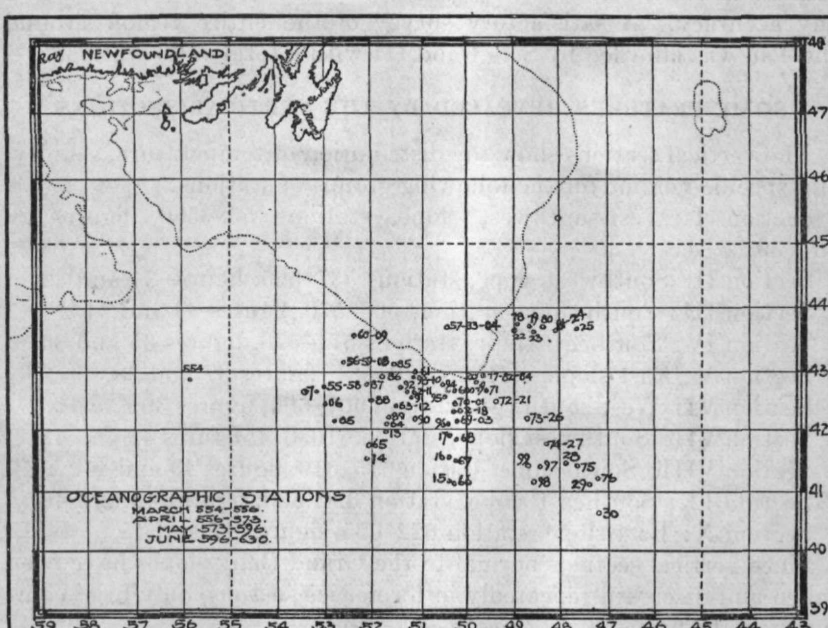


FIG. 28.—Chart of oceanographic stations occupied in 1926

STATION WORK PERFORMED IN 1926

The 1926 ice season marked the first attempts to employ the scientific methods explained in United States Treasury Bulletin No. 14,

[2] Smith, Edward H.: A Practical Method for Determining Ocean Currents. U. S. Treas. Dept. Bull. No. 14, 1925.

and the work was bent wholly towards contributing direct practical information on the behavior of those icebergs that drifted south of the Tail of the Grand Bank. In the course of the season a total of 76 stations were taken, all but three of which were occupied in the deep water off the slope to a depth of 750 meters. This number of stations is less than for 1923 or for 1924; but their value was consequently greatly enhanced by their being well distributed over the area to be surveyed, with each station in the set taken in rapid succession. We were handicapped during the early part of the season by the breaking down of the oceanographic winches on board both the *Tampa* and the *Modoc*, so that the first set of stations was not actually begun until April 29, after the patrol had been in progress more than a month. It was deemed best to make a general survey of the entire ice area at the beginning of the season and a second one at its close. During the progress of the season it was not found possible to make more than one survey and this was confined to a comparatively small but important area off the southwest slope of the Bank. The critical ice area is of such great extent that it requires at least a total of 12 to 14 stations to delineate the courses of the currents with any accuracy. A satisfactory survey of the entire region around the Tail was afforded by Sets I and III with a total of 26 stations.

SOME FEATURES REVEALED BY THE VERTICAL SECTIONS

The vertical sections show the distribution of temperature, salinity, and specific volume for the following groups of stations:

Section I: West-southwest slope, stations 558–560, figures 29 and 30.

Section II: Southwest slope, stations 557–565, figures 31 and 32.

Section III: South slope, stations 566–570, figures 33 and 34.

Section IV: Southeast slope, stations 571–576, figures 35 and 36.

Section V: East slope, stations 578–581, figures 37 and 38.

Section VI: West-southwest, station 607–609, figures 39 and 40.

Section VII: Southwest slope, station 610–614, figures 41 and 42.

Section VIII: South slope, station 615–619, figures 43 and 44.

Section IX: Southeast slope, station 620–630, figures 45 and 46.

Section X: East slope, station 622–625, figures 47 and 48.

Since vertical sections normal to the Grand Bank slopes have been taken and discussed repeatedly in former ice seasons, only brief comment on the principal features is called for.

Section I: The striking thing about this profile, Figure 29, is the shelf of icy water (temperature below 0° C.), that hugged the slope between 100 and 200 meters, and extended out about 20 miles from the edge. The density wall, as illustrated in Figure 30, was well developed at the time with its highest point approximately 45 miles seaward from the slope.

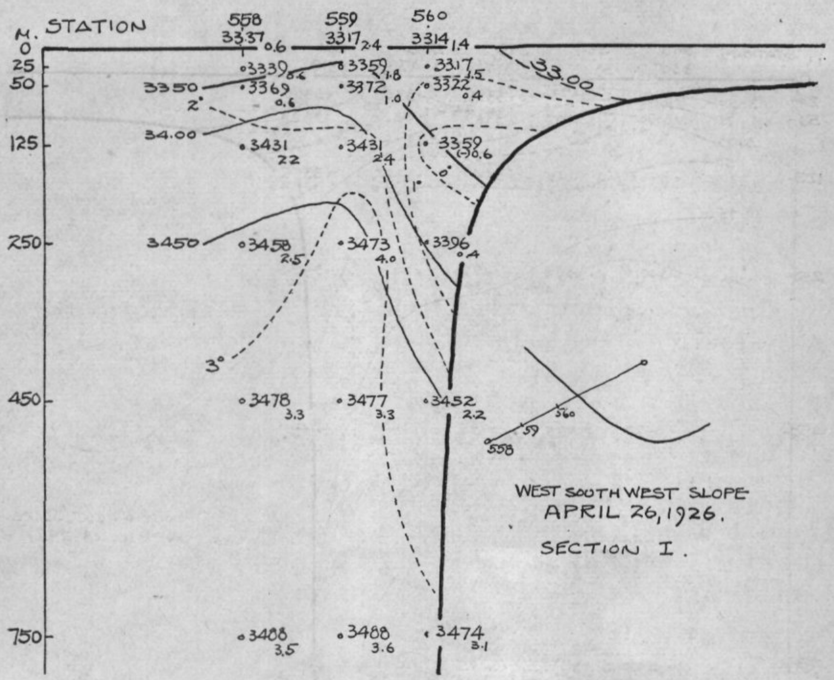


FIG. 29.—Distribution of temperature and salinity

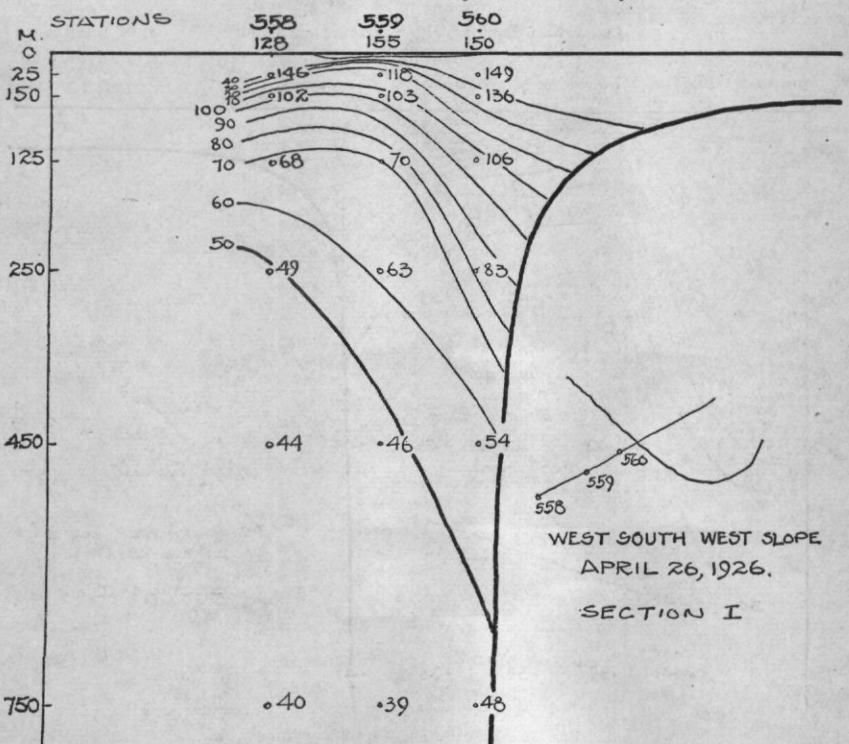


FIG. 30.—Distribution of specific volume

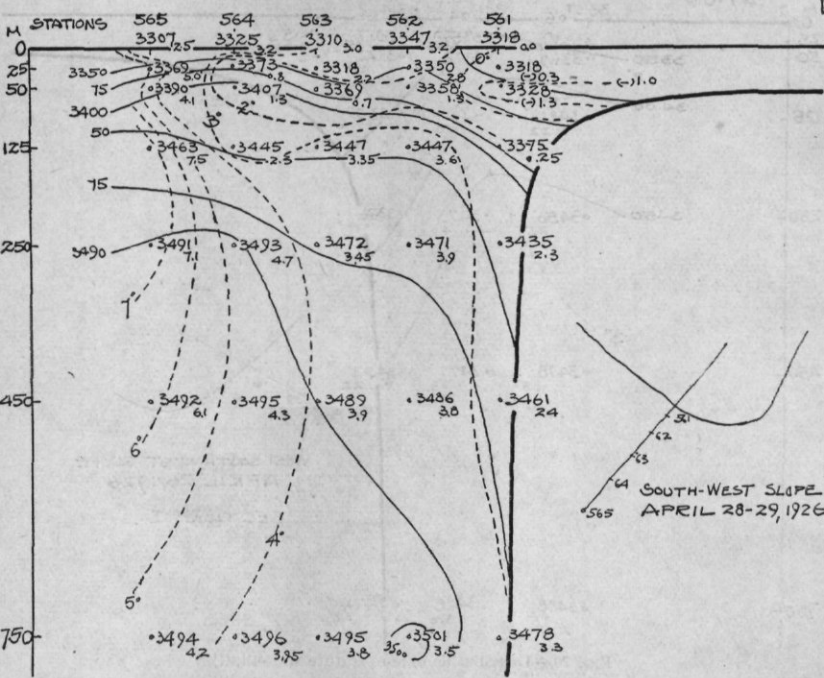


FIG. 31.—Distribution of temperature and salinity

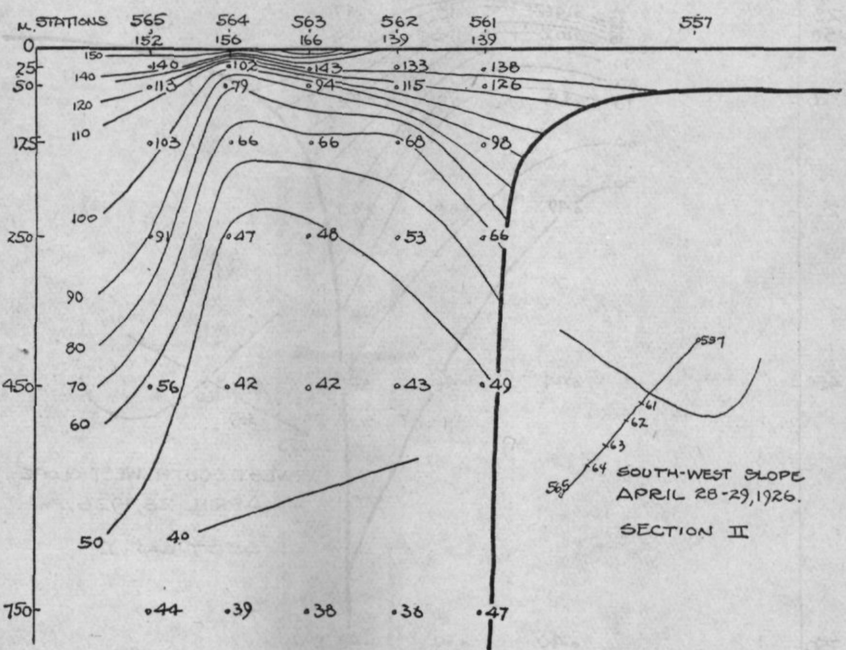


FIG. 32.—Distribution of specific volume

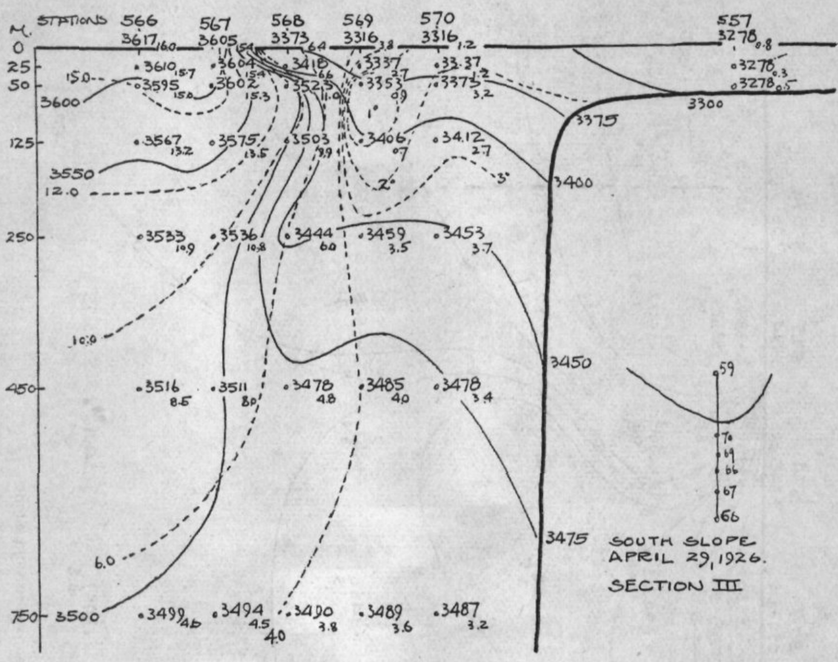


FIG. 33.—Distribution of temperature and salinity

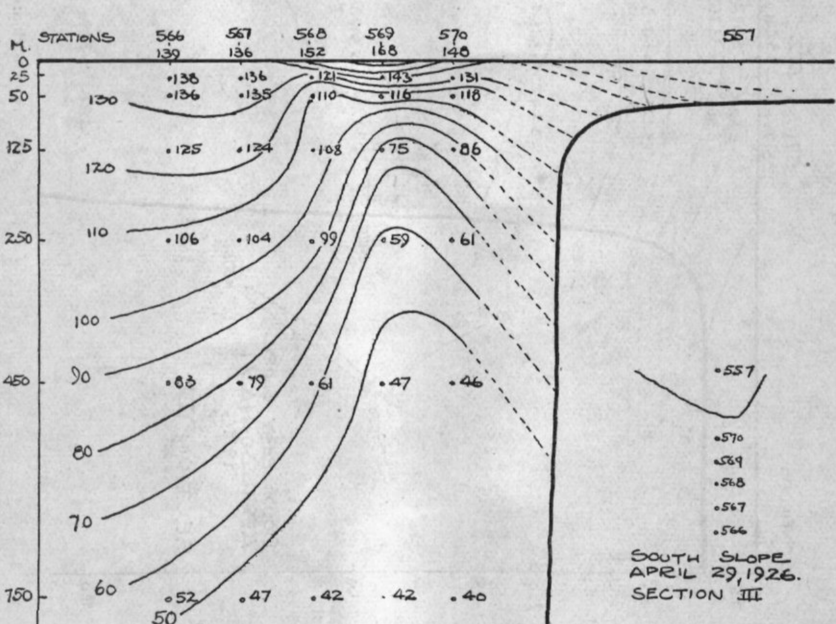


FIG. 34.—Distribution of specific volume

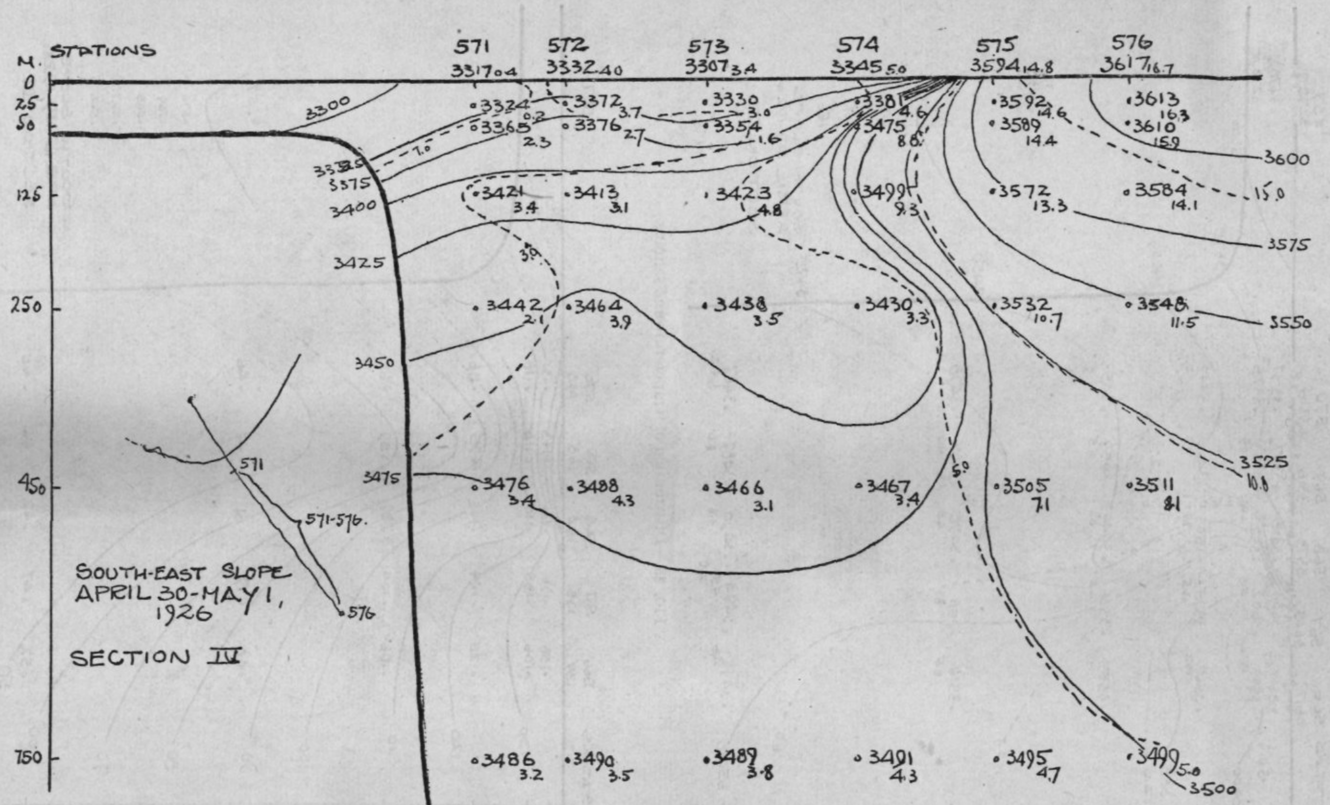


FIG. 35.—Distribution of temperature and salinity

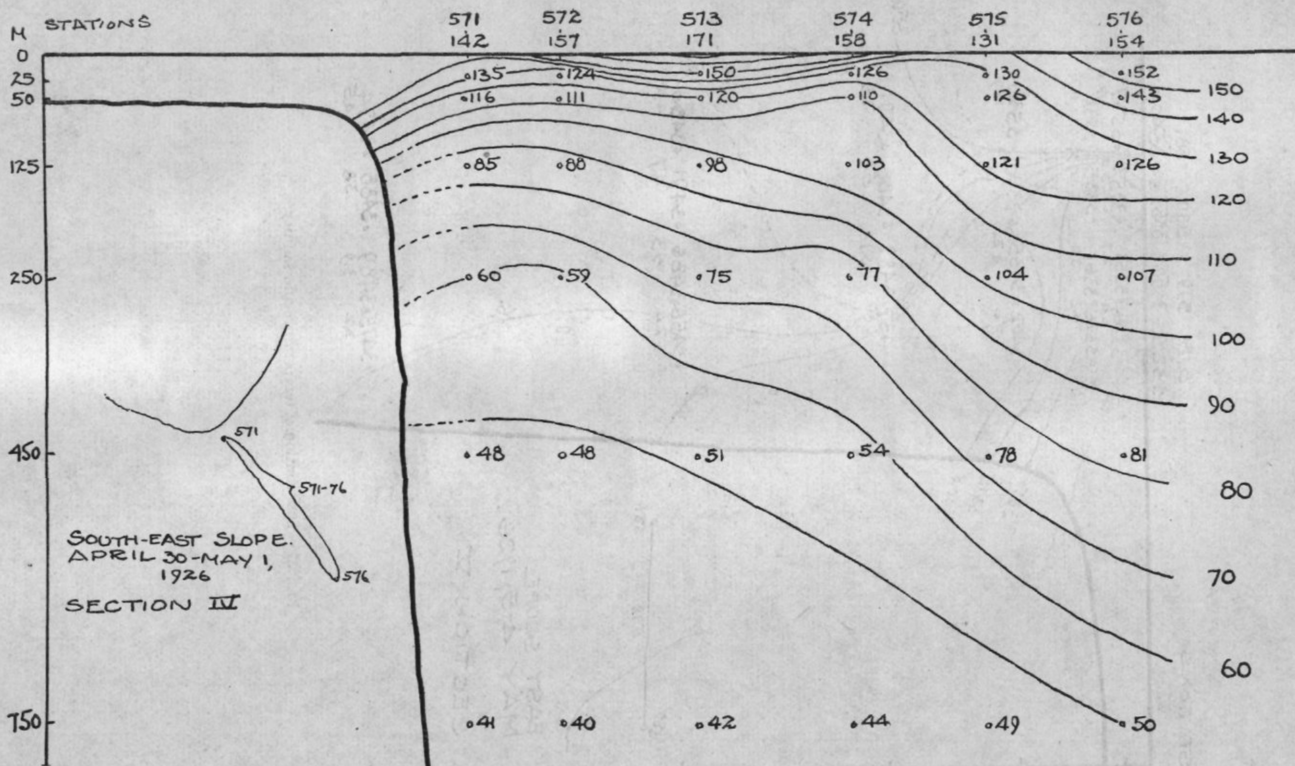


FIG. 36.—Distribution of specific volume

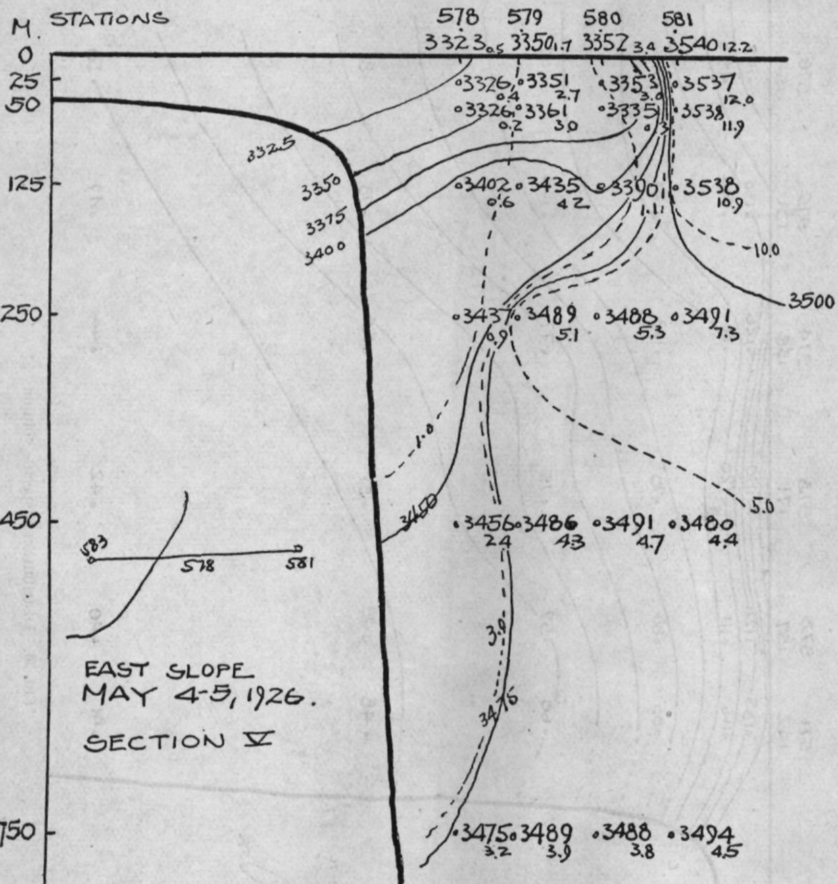


FIG. 37.—Distribution of temperature and salinity

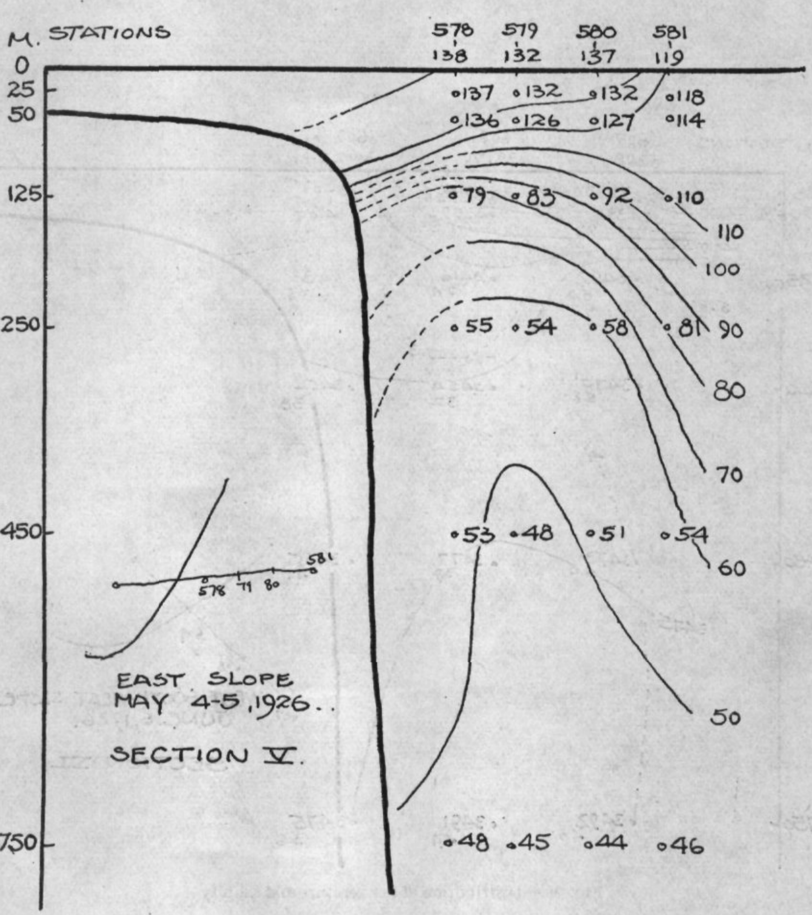


FIG. 38.—Distribution of specific volume

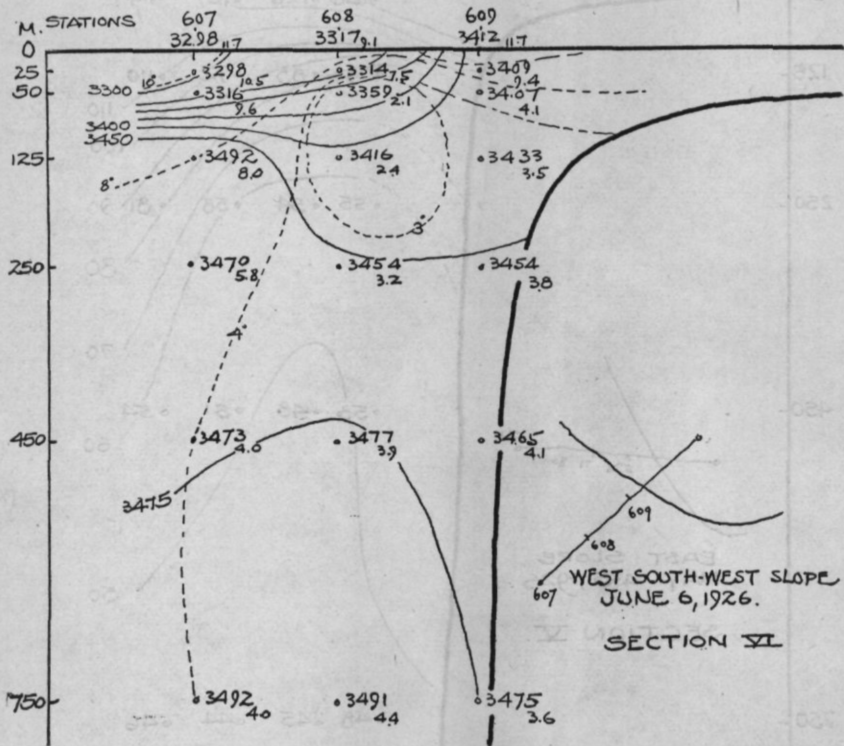


FIG. 39.—Distribution of temperature and salinity

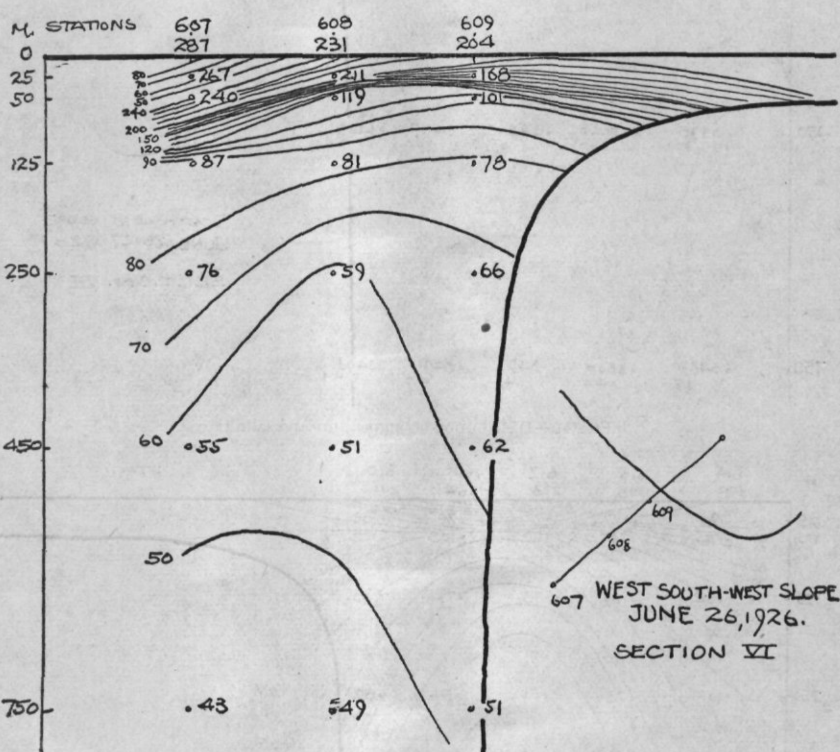


FIG. 40.—Distribution of specific volume

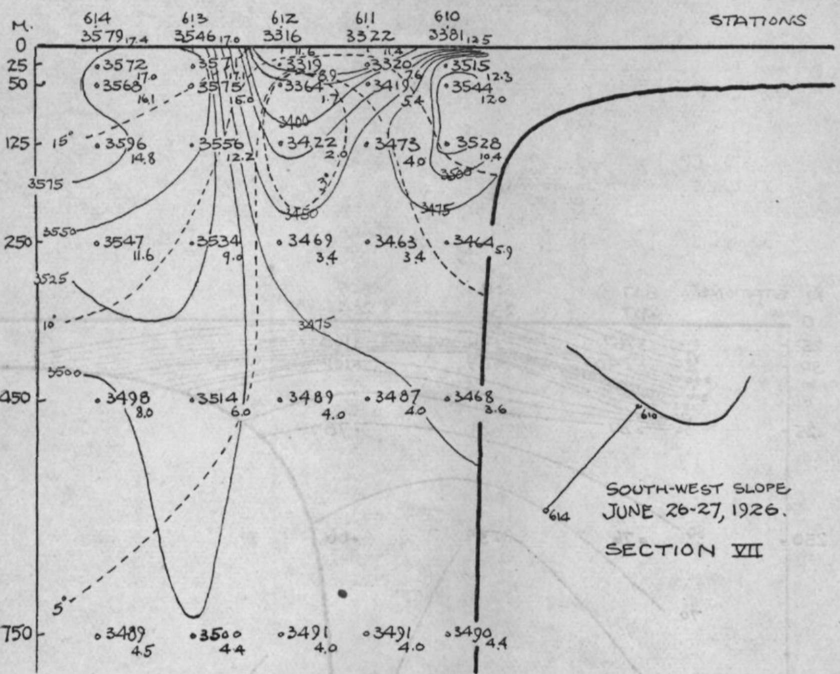


FIG. 41.—Distribution of temperature and salinity

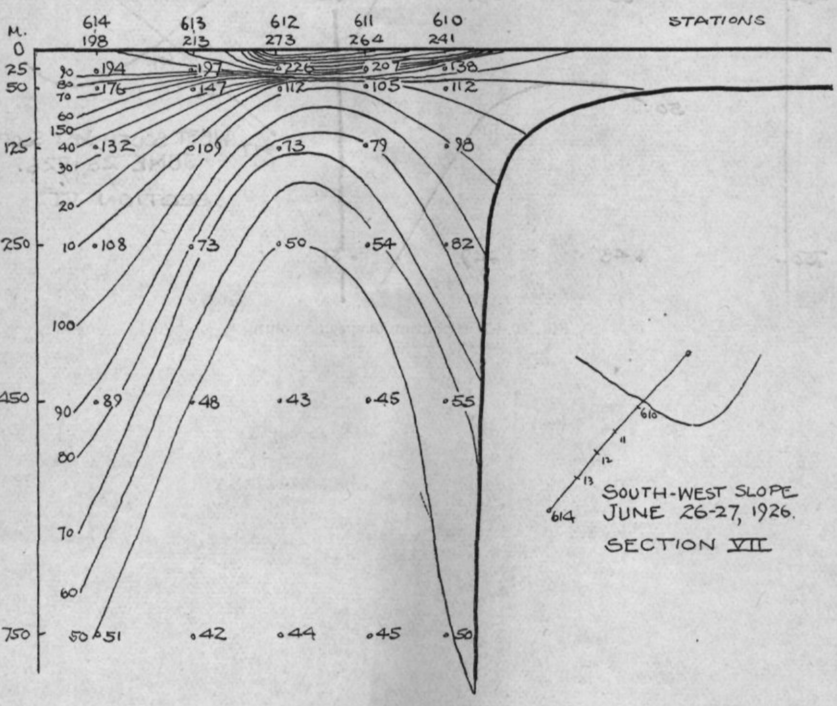


FIG. 42.—Distribution of specific volume

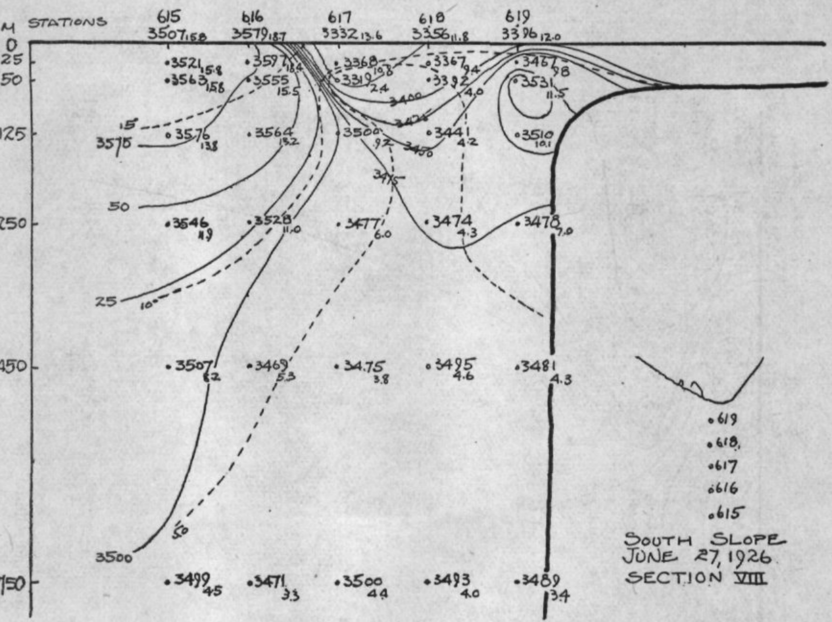


FIG. 43.—Distribution of temperature and salinity

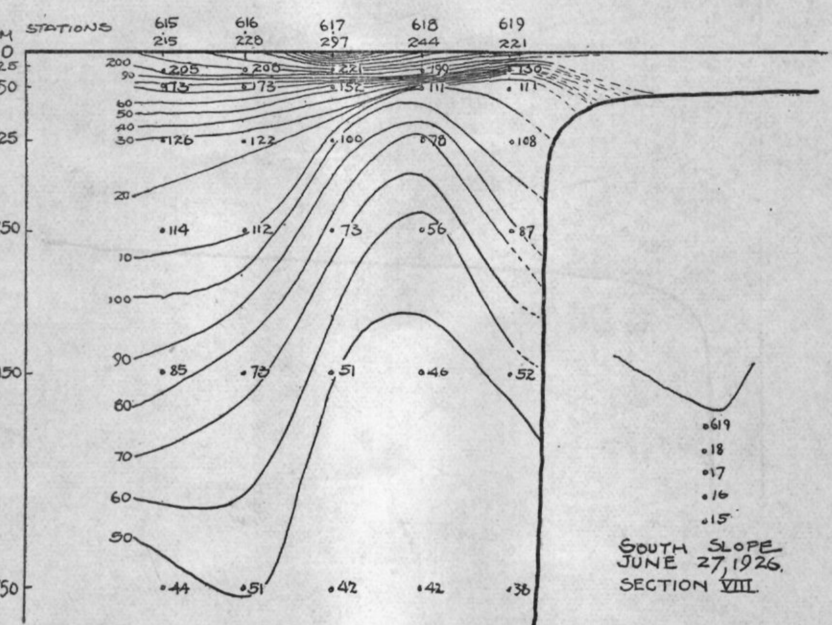


FIG. 44.—Distribution of specific volume

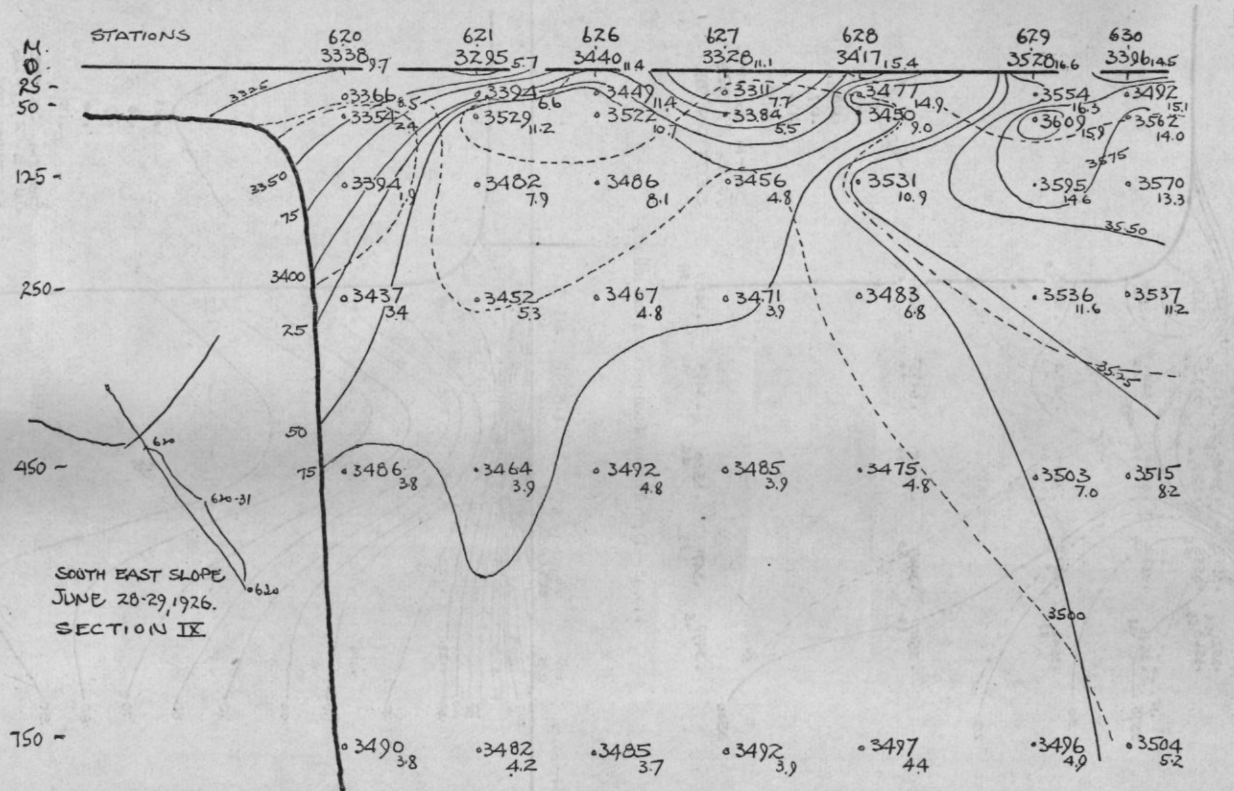


Fig. 45.—Distribution of temperature and salinity

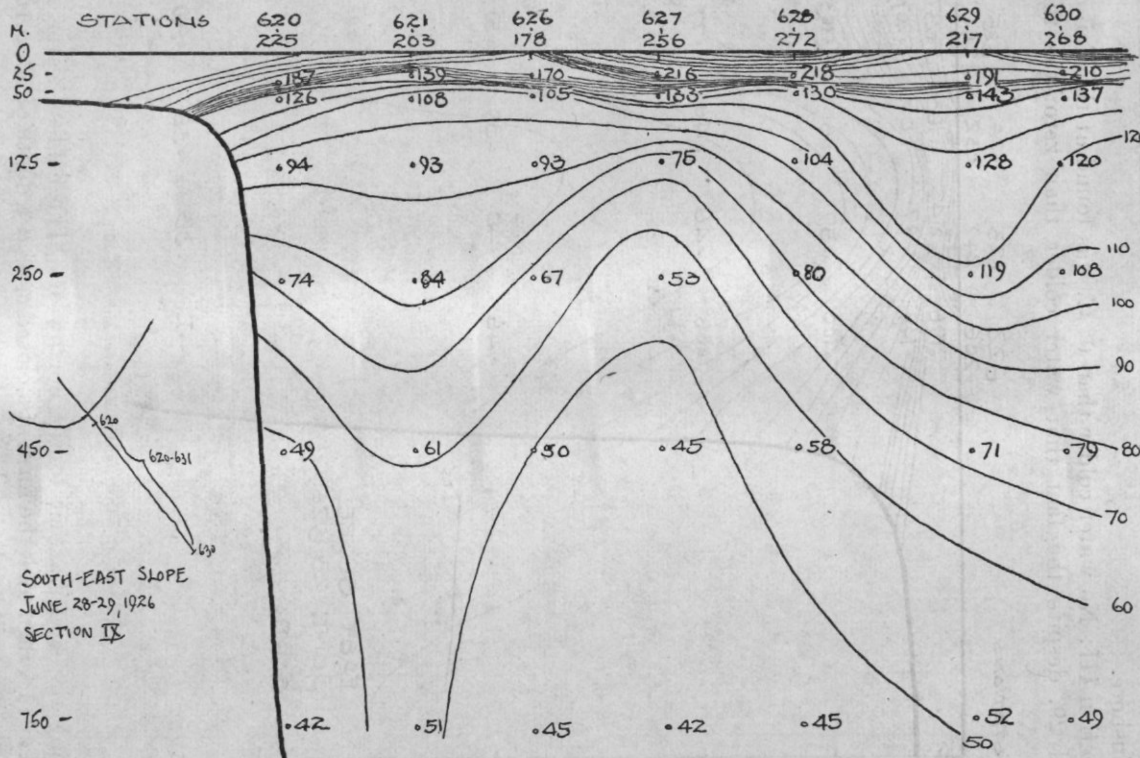


FIG. 46.—Distribution of specific volume

Section II: A cold surface layer 125 meters in thickness spread out from the edge for a distance of 75 miles. The corresponding profile anomaly of specific volume, Figure 32, indicates a much steeper slope to the isosteres on the offshore side of the density wall than on the inshore.

Section III: No water colder than 0° C. was found at the Tail on April 29, despite the fact that water colder than zero was then

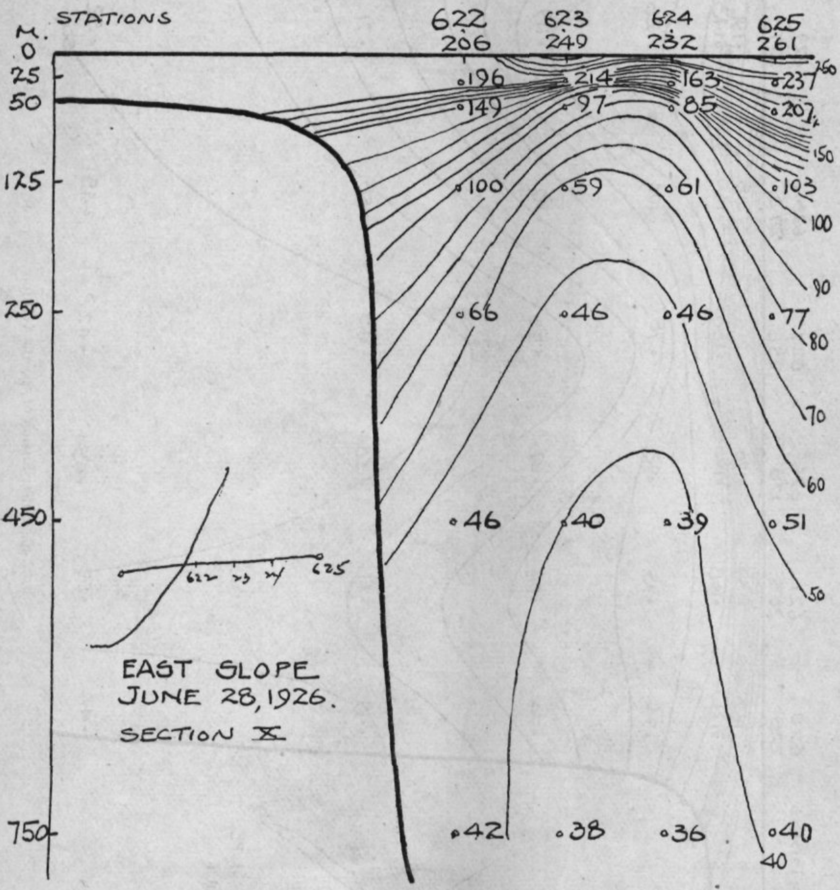


FIG. 47.—Distribution of temperature and salinity

bathing the slope farther to the northwest. The coldest water at the Tail, 1°, then took the form of a closed core at a depth of 50 to 100 meters, situated about 45 miles off the slope. The warm salty water at the outer end of this section is unmistakably that of the Gulf Stream. The density wall, as shown by Figure 34, page 95, was then well developed located near station 569, 45 miles offshore from the Tail. A comparison of Figures 33 and 34, page 95, indicates that the density wall was then approximately 25 miles inshore of the "cold" temperature wall.

Section IV: No extremely cold water was found in this section, but the offshore stations 575 and 576 showed the effects of warm tropical water. The isosteres have a gentle, irregular slope from the inshore station, 571, out to the very end of the picture.

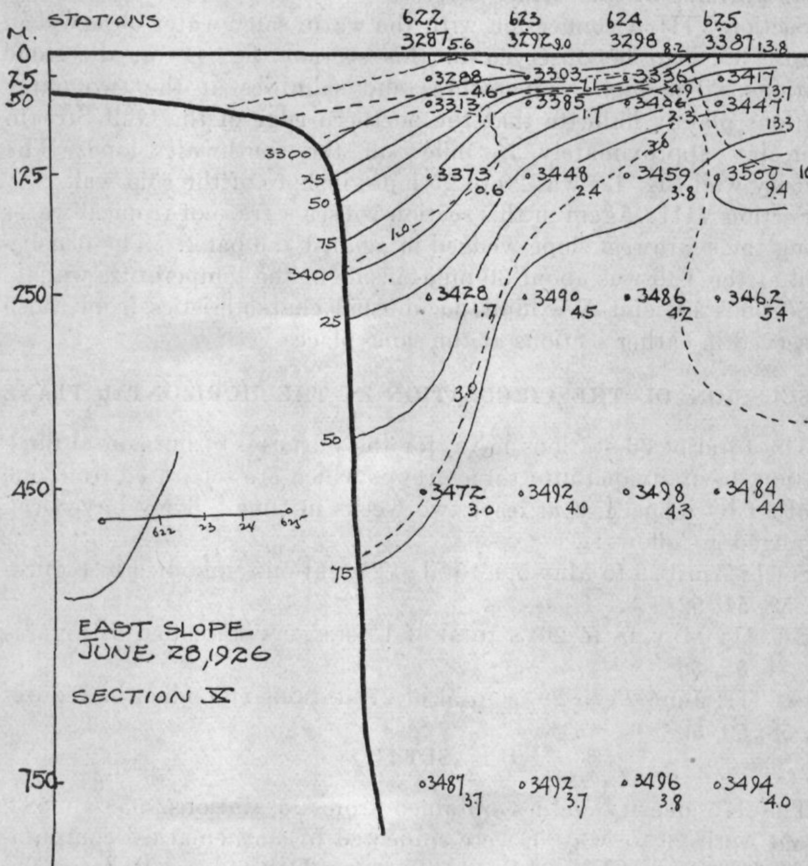


FIG. 48.—Distribution of specific volume

Section V: The inner edge of the Gulf Stream was reached at station 581 while the inshore stations showed no water colder than 0° C. The density wall lay 25 miles inside of the "cold" temperature wall. (Cf. fig. 37 with fig. 38, pp. 98, 99.)

Section VI: To our surprise a pool of relatively warm and fresh water was found at the offshore station on this section. It is difficult, to explain its source unless it had drifted out from the Grand Bank, curling around the end of the cold current which usually extends northwestward along the slope from the Tail, at that season. Doubt-less the body of warm salty water which bathed the slope inshore on this section had its source in the inner edge of the Gulf Stream, the development of this invasion is plainly discernible on the horizontal charts of circulation. The increased number of isosteres in the profile of specific volume (fig. 40), over what were present in this locality six weeks earlier (fig. 30) represents the influence of increased solar warming of the surface layers.

Section VII: A connection with the warm salty water observed in Figure 39, is to be observed in this section (fig. 41) at the slope stations. The high temperatures and salinities at the two outer stations plainly indicate that the northern edge of the Gulf Stream then lay approximately 75 miles off the southwest slope. The density wall (fig. 42) was 20 to 25 miles inshore of the cold wall.

Section VIII: Again in this section we see a trace of tropical water along the southwest slope wedged in against the bank. The density wall at the Tail was about 30 miles inside of the temperature wall.

Sections IX and X exhibit no unusual characteristics from those observed in earlier sections at the same places.

DISCUSSION OF THE CIRCULATION IN THE HORIZONTAL PLANE

The total of 76 stations have, for the purposes of horizontal illustration, been divided into three groups which are separated from one another by a space of at least two weeks in time. They have been arranged as follows:

Set I: April 29 to May 5, a total of 25 stations embodied in Figures 49, 50, 51, 52.

Set. II: May 18 to 20, a total of 13 stations embodied in Figures 53, 54, 55, 56.

Set III: June 25 to 29, a total of 27 stations embodied in Figures 57, 58, 59, 60.

SET I

The 175 density values obtained from 25 stations, 558 to 583, taken April 29 to May 5, were subjected to mathematical computations described in United States Treasury Department Bulletin No. 14, giving the values shown in the last four columns in the oceanographic station table, page 78. Since we assumed that the maximum depth of observation, 750 meters (or decibars), was a level isobaric plane, the dynamic values of 728+ given on the charts (figs. 49, 53, and 57) represent the height of the sea surface in dynamic meters at each station. (See Oceanographic station table, p. 78, for a detailed record of these data.) The dynamic heights have been plotted at the proper station positions on Figure 49, page 109, and contour lines delineating the topography of the sea surface were drawn in similar fashion to those which appear on an ordinary isobaric weather map. The dynamic topographical map (fig. 49) is read also in the same manner as one reads a meteorological map. The oceanic situation around the Tail of the Grand Bank April 29 to May 5 may be described as follows: A "low" or hollow in the sea surface lay centered off the southwest slope of the Grand Bank with a trough, circumscribed by the contour of 728.70 dynamic meters, extended around the Tail to the northeastward more or less paralleling the 100-fathom curve. The sea surface was relatively high in over the Bank itself and at the outermost stations offshore. A hill of water, figuratively, lay centered about 65 miles southeastward of the Tail.

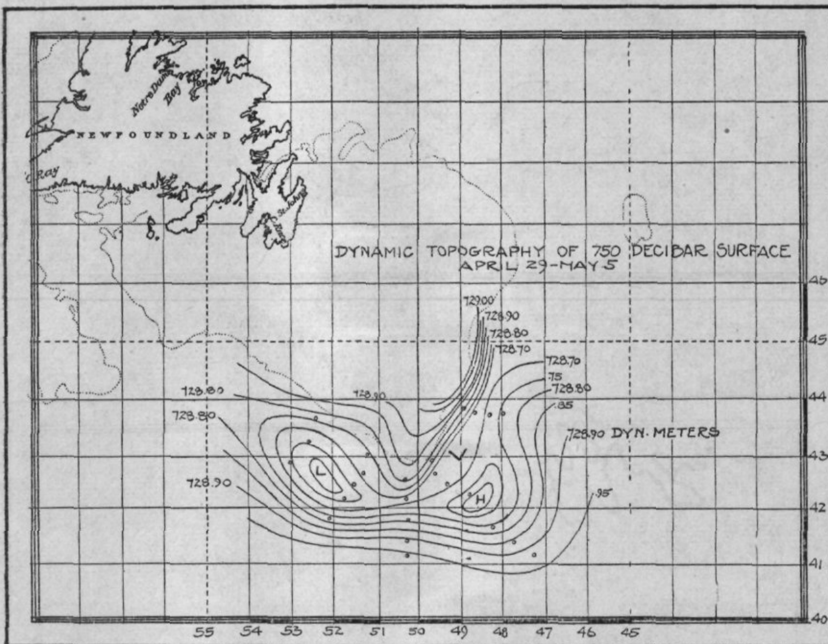


FIG. 49.—Set I. Dynamic topographical map

The circulation of the water, which will follow this dynamic topography of the surfaces is in general as on a weather map, anticlockwise around the "lows" and clockwise around the "highs." Figure 50, page 110, indicates the direction of flow of the water by means of the arrows, and the numerals represent in knots per hour the velocity of the current at the particular place and time. The velocities were calculated upon the assumption that the water had no motion at a depth of 750 decibars (meters). Such, however, was not literally the case, especially offshore in the Gulf Stream, but inasmuch as 750 decibars was the limit of depth to which our observations extended, it is taken arbitrarily as the depth at which motion most nearly approached zero. Reference to Figure 50, page 110, shows

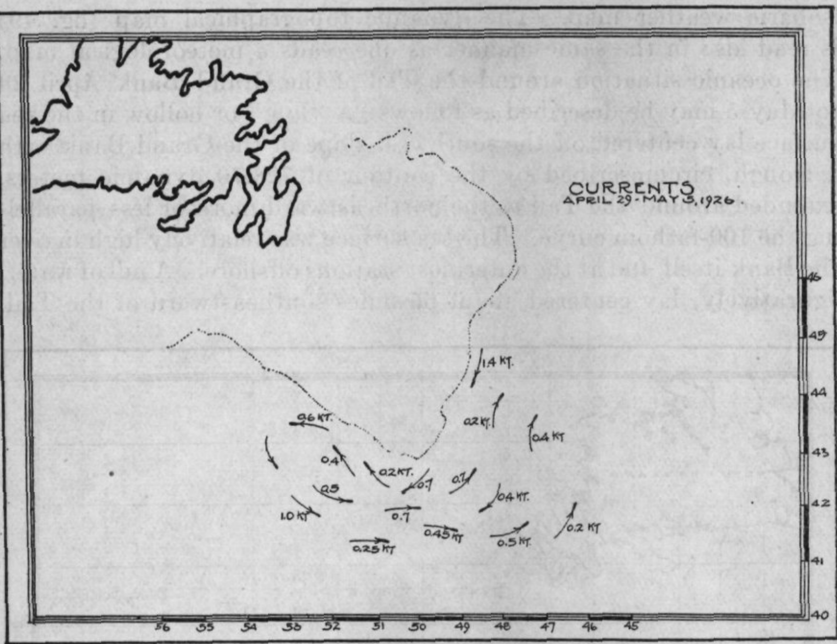


FIG. 50.—Set I. Direction and velocity of the currents

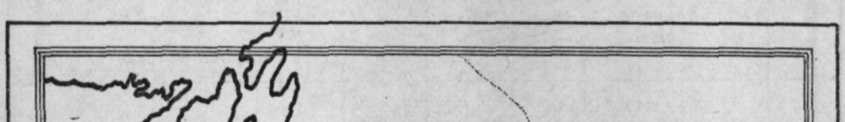


FIG. 51.—Set I. Distribution of cold and warm water

that the cold current was running swiftest along the east side of the Bank at the rate of 1.4 knots per hour, but it decreased to 0.7 knot 60 miles farther south at the Tail. The inshore set (Labrador current) curled around the Tail and flowed northwestward parallel with the continental edge, a distance of 150 miles, as far as our observations extended in that direction. Reaching that locality, a great portion of the current eddied offshore and back to the eastward, forming a vast anticyclonic vortex off the southwest slope. The most rapid rate of flow was 1 knot, located southwest of the Bank, as shown on Figure 50, page 110. The easterly moving water masses were split by a clockwise eddy when they reached a point

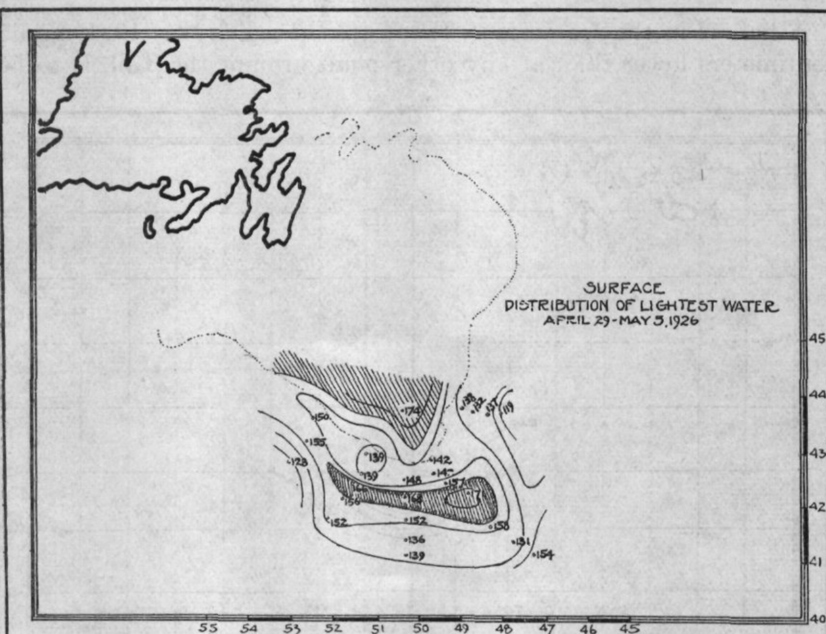


FIG. 52.—Set I. Distribution of light and heavy water on the surface of the sea

southeast of the Tail, but just to the northeast of this point the branches rejoined. The northeasterly counterset was only 25 miles off the eastern edge of the Bank in latitude 44°, but it was weak—0.2 of a knot per hour.

The distribution of cold water, as shown by Figure 51, page 110, is good evidence which supports the general scheme of circulation calculated and portrayed on Figure 50, page 110. The cold water from the north was transported to the Tail and thence along the southwest slope of the Grand Bank as far as our observations in that direction extended. The shape and position of the shaded area of water less than 1° C. (fig. 51, p. 110), clearly indicates that this cold water after being brought to the region of the southwest slope was carried back to the eastward in the form of a counterset, separated from the westerly moving stream inshore by a strip of water about 10 miles in width and with a temperature higher than 1°. The fourth sketch of this set of observations, April 29 to May 5 (fig. 52, p. 111), illustrates the distribution on the surface around the Tail of the lightest water.

The lightest water, which has been inclosed in a shaded area, extended parallel with the slope some 35 miles to the seaward of the 100-fathom contour and had heavier water on either side. Light water also was found in over the Bank itself.

SET II

A hollow in the sea surface, the center of which was 10 dynamic centimeters lower than at any other point around the Tail, is to be

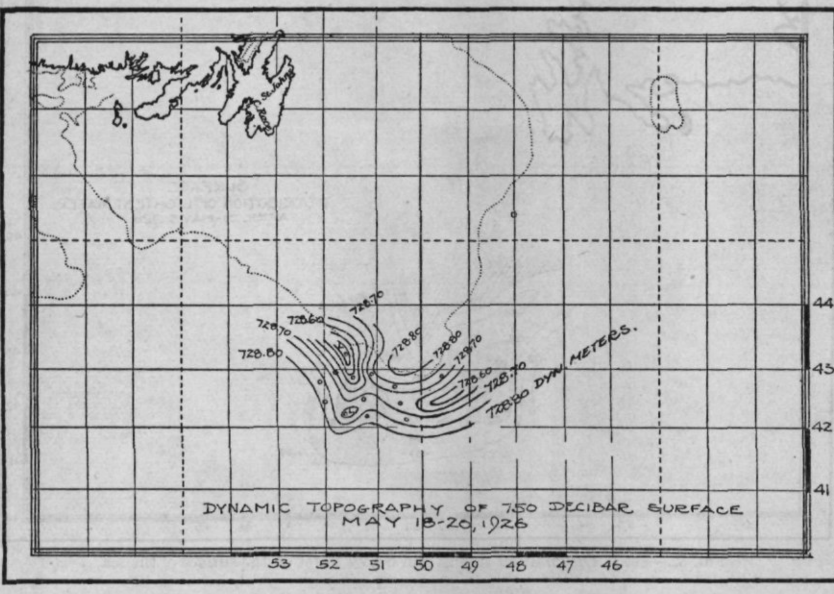


FIG. 53.—Set II. Dynamic topographical map

noted on Figure 53. The same trough of 728.70 dynamic meters that was recorded around the Tail of the Bank two weeks earlier is seen here stretched along the slope. The sea surface was relatively high in over the Bank and offshore at the outer stations, all of which conditions agree with those previously observed this season.

The oceanic situation for May 18 to 20 (fig. 53) reveals the fact that an important change had taken place since the first week in May (fig. 49). These two figures show that the spacious vortex observed in the sea surface off the southwest slope April 29 to May 5 had been pushed up against the edge of the Bank by a force acting

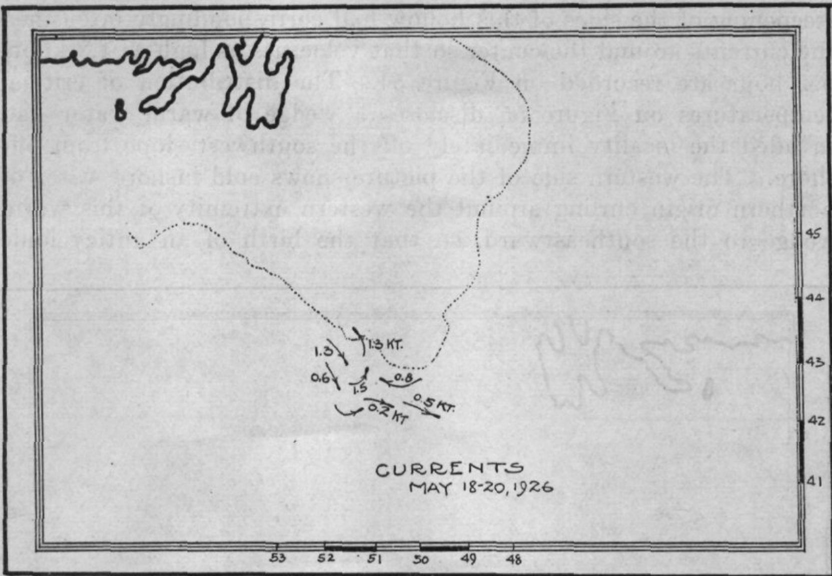


FIG. 54.—Set II. Direction and velocity of the currents

FIG. 55.—Set II. Distribution of cold and warm water

from offshore to the southwest, and this action, moreover, had tended to deepen the vortex by about 10 dynamic centimeters. The steepening of the sides of this hollow had correspondingly intensified the currents around the center so that velocities as high as 1.3 knots per hour are recorded on Figure 54. The distribution of critical temperatures on Figure 55 discloses a wedge of warm water had invaded the locality immediately off the southwest slope from offshore. The western side of the picture shows cold inshore water of northern origin curling around the western extremity of this warm wedge to the southeastward, so that the birth of an anticyclonic

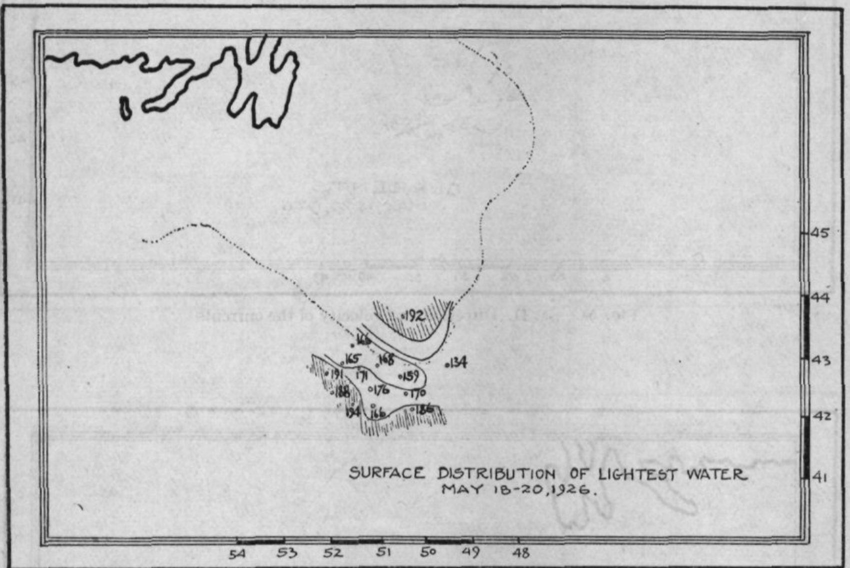


FIG. 56.—Set II. Distribution of light and heavy water on the surface of the sea

rotating eddy is clearly indicated off the southwest slope of the Bank. The lightest water on the surface lay in over the Bank and also offshore at the outer stations, a distribution very similar to that which prevailed two weeks earlier.

SET III

A study of the dynamic topographical map for the period June 25 to 29 shows that the hollow in the sea surface off the southwest slope of the Bank (figs. 49 and 53) had again expanded to about the same form as in early May, except for being slightly more elongate and curling a few miles further to the eastward. A trough extended southward paralleling the east slope of the Bank and at a distance out about 50 miles. The direction and velocity of the currents are shown on Figure 58 as also the drift of two bergs which were sighted

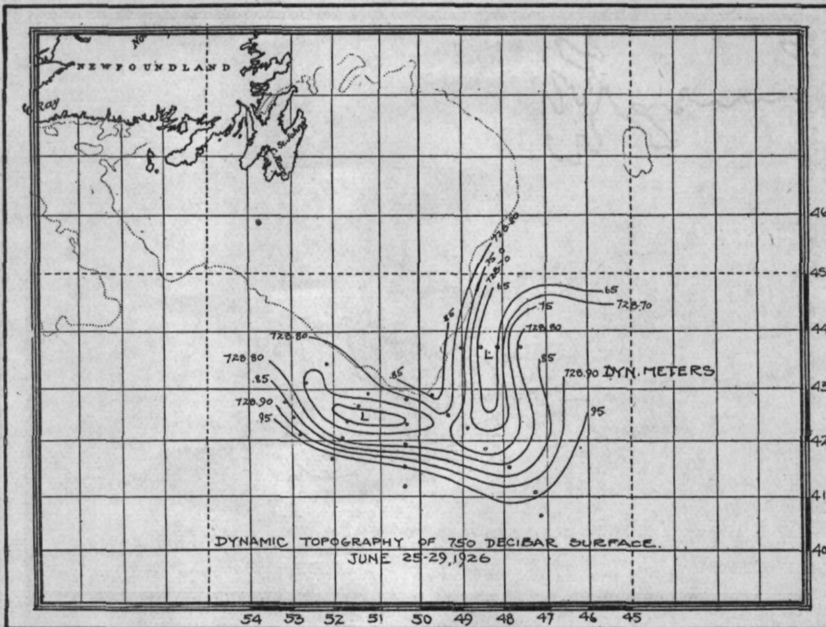


FIG. 57.—Set III. Dynamic topographical map

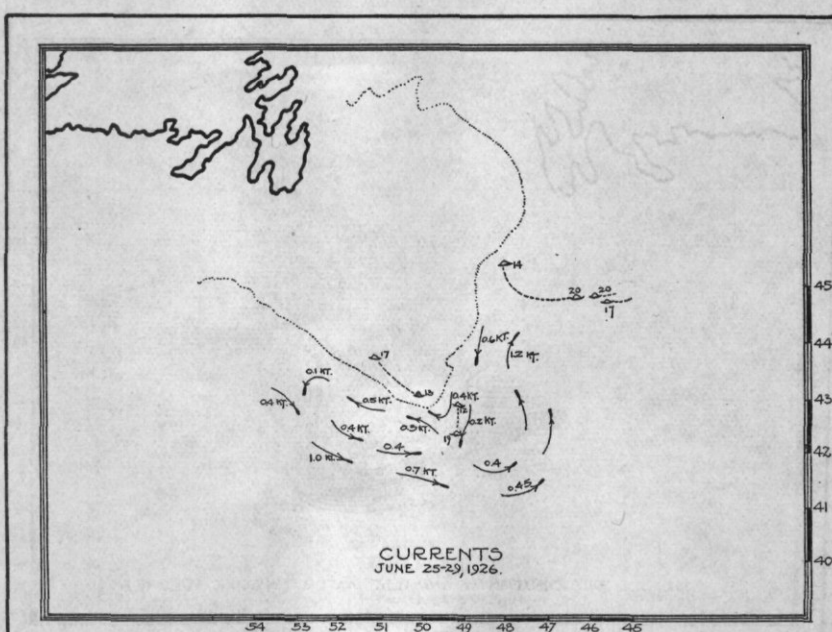


FIG. 58.—Set III. Direction and velocity of the currents

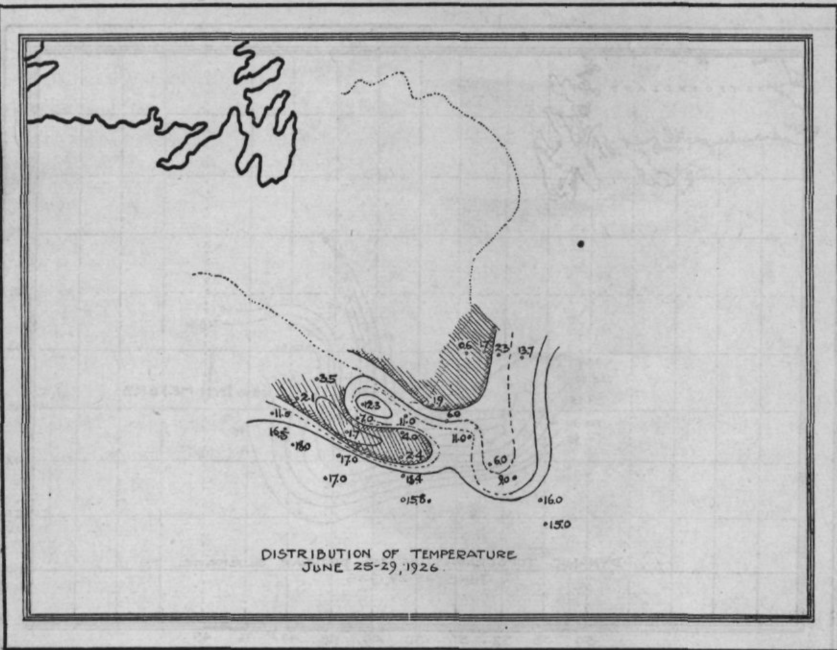


FIG. 59.—Set III. Distribution of cold and warm water

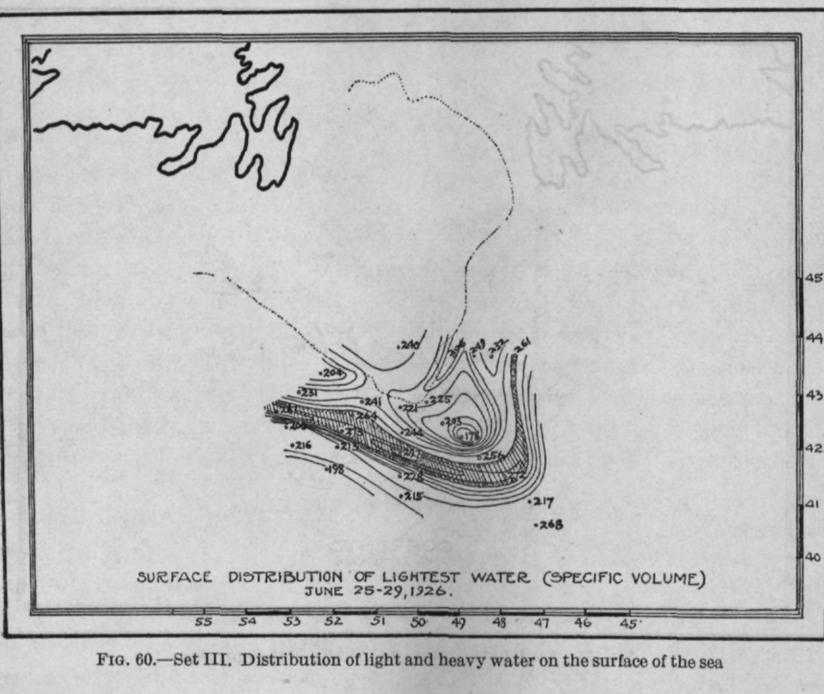


FIG. 60.—Set III. Distribution of light and heavy water on the surface of the sea

in the area at the time. The behavior of the ice conforms as might be expected to the circulation as denoted on the map. The distribution of temperature as plotted on Figure 59 plainly shows that warm water previously mentioned on Figure 55 had worked its way to the northwestward along the Bank slope, while on the other hand cold water from the north curled offshore 150 miles or so westward of the Tail, finally to be carried along in a return stream to the eastward, 30 to 40 miles off the continental edge. A comparison of this map with the two earlier temperature charts, Figures 51 and 55, shows the development of this rotating movement of the warm and cold waters. The lightest surface water (fig. 60) was in the form of a band 25 to 30 miles in width and more or less paralleling the Bank contour about 60 miles offshore. The effect of solar warming of the surface layers during the latter part of June is clearly shown by the increase in values for the specific volumes from those collected for May. (Fig. 52.)

SUMMARY

The work this year marks the first attempt at dynamic calculation of ocean currents on board a surveying vessel immediately following the collection of the data and also the employing of such information at once for the benefit of passing ships. The three sets of observations (figs. 49, 53, and 57) permit us to follow the changes that took place in the circulation around the Tail of the Bank from April 29 to June 30. First, we may regard the circulation as found by the earliest survey as more or less characteristic of the waters around the Tail of the Grand Bank. On or about May 15 warm salty water from offshore interrupted this scheme of circulation by pushing in toward the southwest slope and pinching off the flow of Arctic water that normally drifts clockwise around the Atlantic face of the Grand Bank. This movement characterizing the currents in May had slackened before the latter part of June, and the scheme of circulation had returned to what we regard as normal. Except for this unexplained interruption the cold current continually flowed around the Tail and to a variable distance (approximately 150 miles), along the southwest slope where it turned to the eastward, joining the warm current known as the Gulf Stream. This distribution and direction of the currents tended to form a great anticyclonic eddy off the southwest slope of the Grand Bank.

RELIABILITY OF CURRENT MAPS

One of the problems upon which we wished to gain information as a result of the season's work, was the rate of change in direction and velocity of ocean currents, to tell whether one survey a month would serve all practical purposes or whether rapid changes in the circulation would make more frequent surveys necessary. There have been very little data collected from the ocean which throw much light on this subject. In case we argue from the atmosphere we know that isobaric maps as much as 24 hours old contain little information on the situation for the present. The scheme of oceanic circulation around the Tail of the Bank this season altered quite noticeably within a space of two weeks and then resumed, broadly speaking, its original state, all within the priod of two months.. It is hoped that the same plan of oceanographic work introduced in 1926 is continued for a few years so that we shall be in a position to say considerable more on the reliability of current maps with the elapse of time.

DISSIMILARITY BETWEEN DENSITY AND COLD WALLS

The observations in 1926 corroborate earlier ones to the effect that the density of the water around the Grand Bank is usually higher along the zone of contact between the Labrador current and the Gulf Stream than on either side of the latter. But this density wall does not exactly coincide in location with the zone of most abrupt transition from low to high temperature (the cold wall), but lies as a rule 25 to 35 miles inshore of the latter. Since the density wall unquestionably marks the boundary between the easterly and westerly sets, this discovery means that the drop in the temperature of the surface water near the continental slope does not mark the change in the direction of the current.

LIGHT WATER COLLECTS ON SURFACE OF THE SEA

Evidence has been accumulating that there is a prevailing tendency for relatively light water to collect on the surface of the sea immediately over the belt of the heaviest subsurface water, represented by the density wall; this has been observed in the profiles of every ice season since 1922, so it must be more than a coincidence.

DRIFT OF BERGS CHECKED WITH CALCULATED CURRENTS

We were handicapped this year by fog in comparing the drift of the bergs with the currents calculated and plotted, but the few examples obtained have been found to harmonize. (Fig. 21, p. 73.) The fact that there were few opportunities to make comparisons in the case of specific bergs ought not to be interpreted as detracting from the value of the three sets of illustrations represented by Figures 49, 53, and 57, all of which were continually consulted by those in charge of maneuvering the patrol ships.

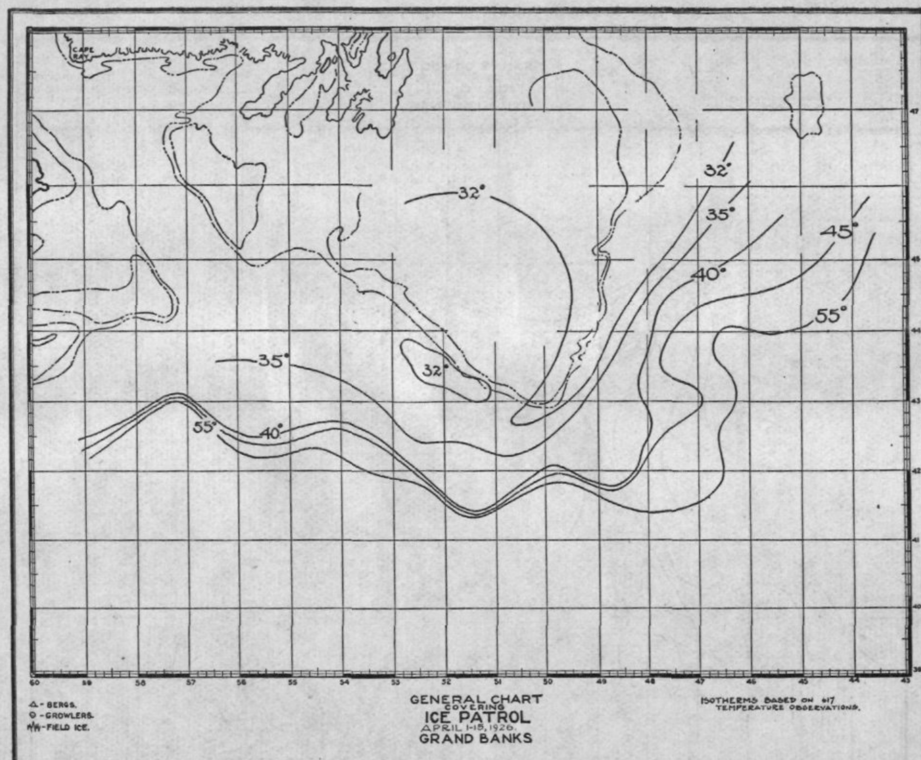


FIG. 61.—Distribution of temperature on the surface April 1 to 15

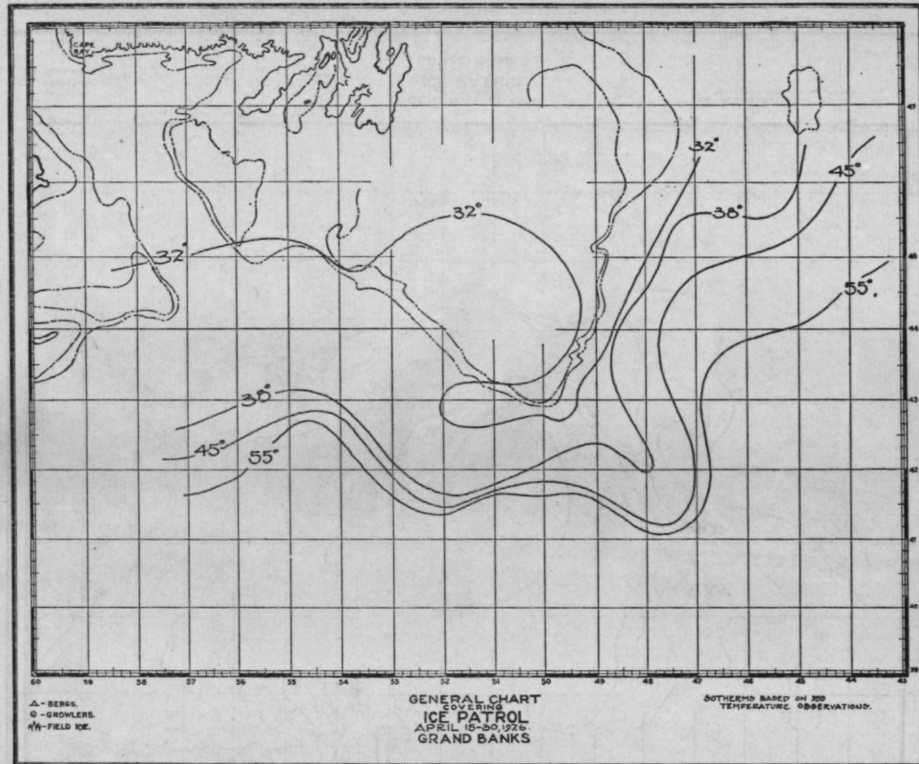


FIG. 62.—Distribution of temperature on the surface April 15 to 30

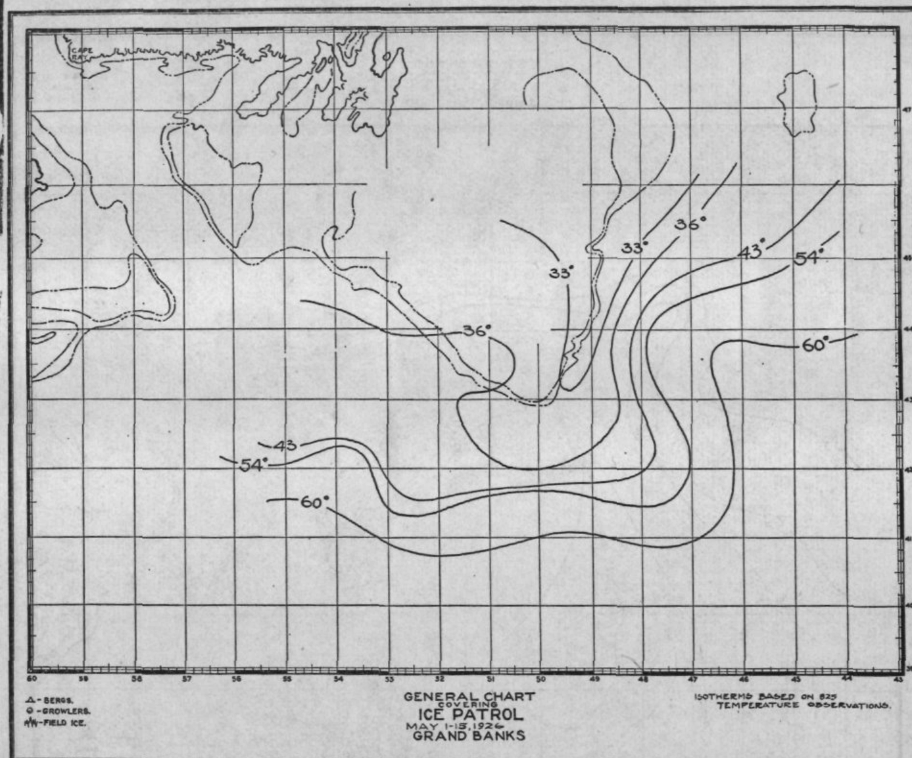


FIG. 63.—Distribution of temperature on the surface, May 1 to 15

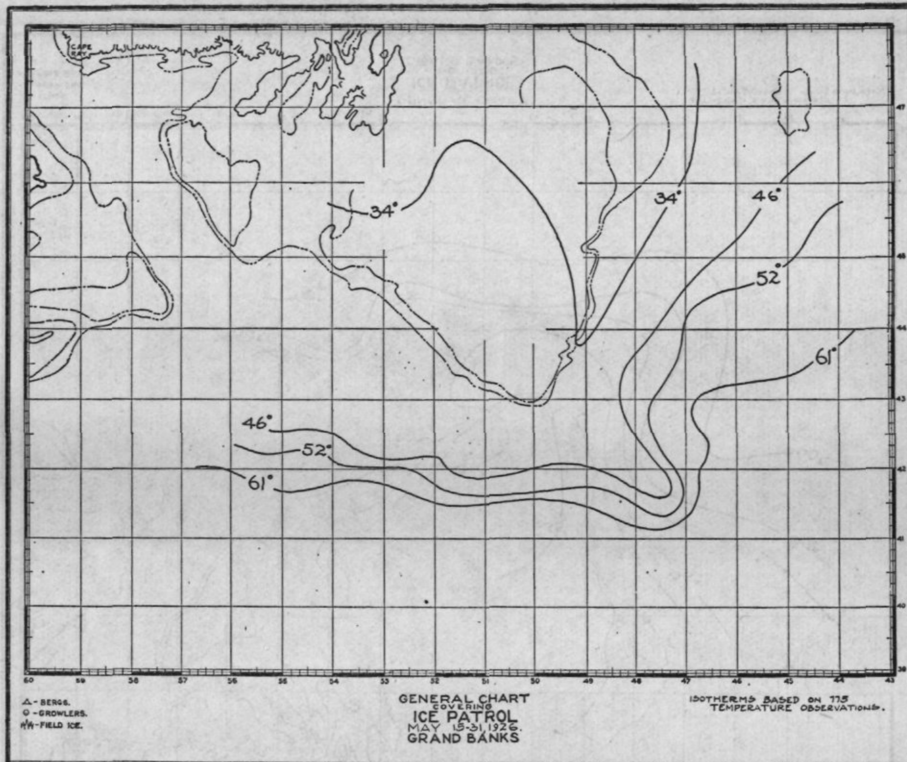


FIG. 64.—Distribution of temperature on the surface, May 15 to 31

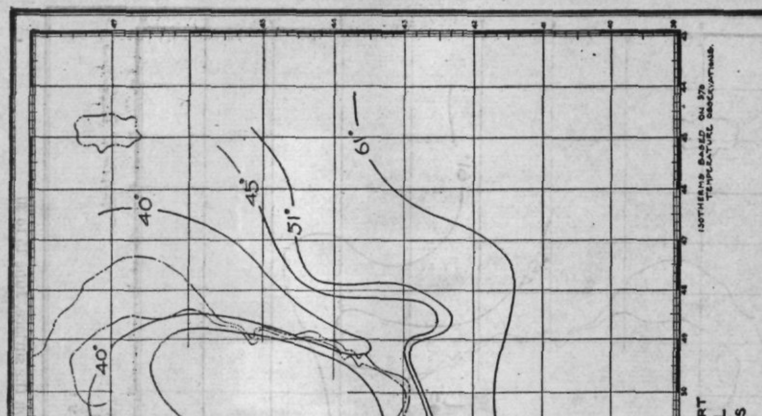


FIG. 65.—Distribution of temperature on the surface, June 1 to 15

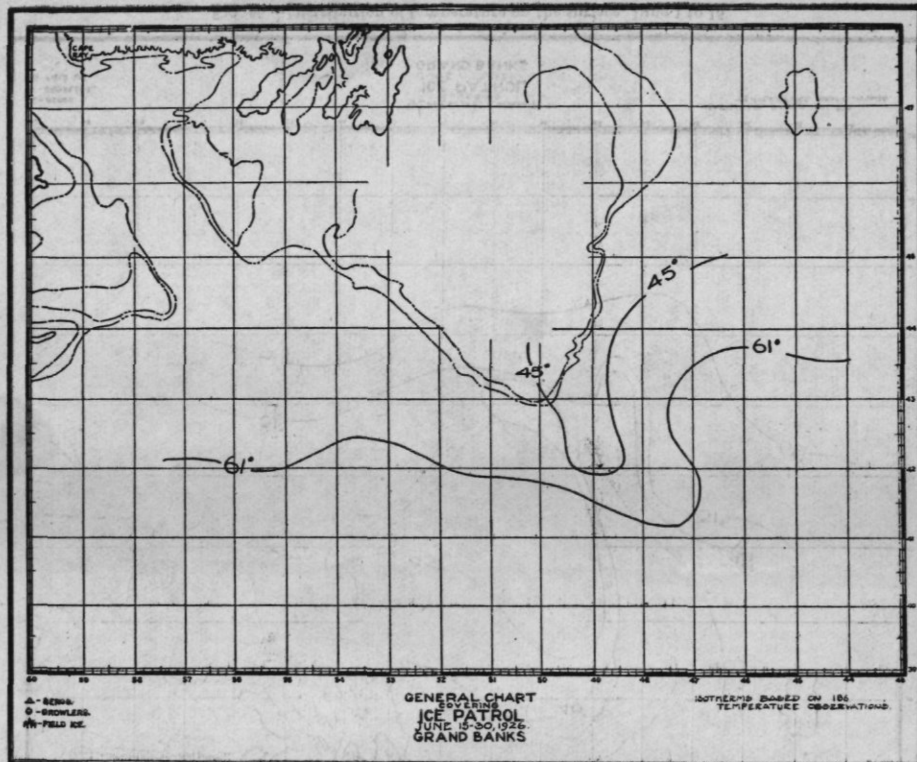
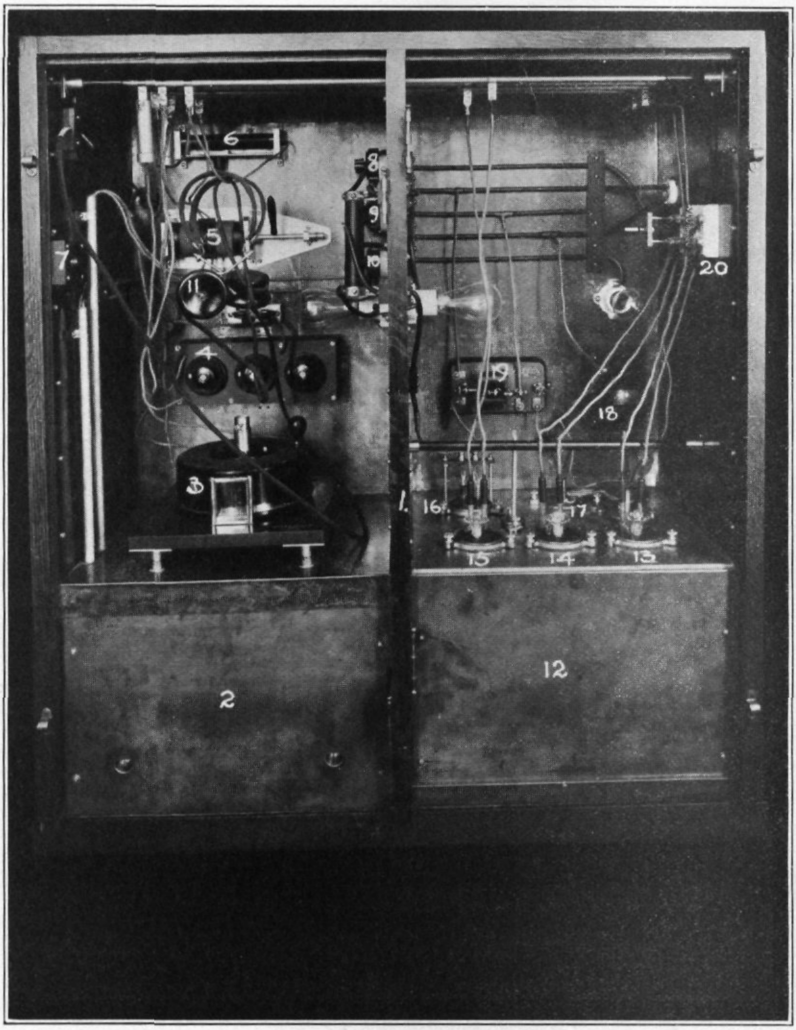


FIG. 66.—Distribution of temperature on the surface, June 15 to 30



THE ELECTRIC SALINITY TESTER

1. Wooden partition dividing cabinet; all walls copper shielded. 2. Chamber containing microphone hummer. 3. Slide wire. 4. Resistance Q. 5. Mutual inductance. 6. Slider. 7. Push-button switch connection to the measuring circuit. 8. Snap switch for extra heater circuit. 9. Snap switch for heater in series with relay. 10. Snap switch for stirring motor. 11. Head telephone detectors. 12. Immersion tank. 13. Test cell X. 14. Test cell X. 15. Auxiliary cell Y. 16. Thermostat. 17. Heater. 18. Stirring motor. 19. Relay. 20. Throw switch for X cells 14 and 13

THE ELECTRIC SALINITY TESTER

The ice-patrol bulletins for 1924 and 1925 (Nos. 12 and 13) contain sections [1,2] devoted to the description and method of operation of the electric apparatus for measuring the conductivity of sea water, providing a ready means of determining the salinity of water samples on shipboard. The United States Bureau of Standards constructed one such apparatus, which was first placed in successful operation the season of 1924, when some 600 odd samples of sea water were tested. Concurrent with the progressive scientific program laid down for the 1926 patrol, which attempts to follow the drift of icebergs by keeping an up-to-date current map on board the patrol ship, it became necessary to provide both ships with the apparatus, instead of one as in the past. Salinity determinations during the season of 1926 were thus made immediately after occupying each station and thus we were able to compute the dynamic value, and so to construct a current map on the spot. The new salinity tester was constructed with the cooperation of the Bureau of Standards in time for installation and calibration on board the *Tampa* before she sailed in March. The old set was placed on board the *Modoc*, and both machines, it ought to be added, are alike in detail. A total of about 537 salinity determinations were made during the season of 1926, and no difficulties were experienced with the functioning of the apparatus. A conversion table of scale readings to salinities follows, for use in the operation of these or similar sets in the future.

The scale range of the instrument readings it will be noted extends from 0 to 800. Readings higher than 800 are obtainable by continuing the graph of salinities plotted against instrument readings and checked occasionally by an actual test of a sample of known salinity within the discussed range.

A table of scale readings of the electric salinity tester with the corresponding values of salinity is shown herewith:

Reading	Salinity	Reading	Salinity	Reading	Salinity	Reading	Salinity	Reading	Salinity
0	28.820	10	28.895	20	28.977	30	29.060	40	29.145
1	28.825	11	28.900	21	28.985	31	29.070	41	29.154
2	28.835	12	28.910	22	28.993	32	29.080	42	29.163
3	28.845	13	28.920	23	29.000	33	29.088	43	29.170
4	28.850	14	28.925	24	29.010	34	29.095	44	29.180
5	28.855	15	28.935	25	29.020	35	29.103	45	29.190
6	28.865	16	28.945	26	29.027	36	29.112	46	29.200
7	28.870	17	28.954	27	29.035	37	29.120	47	29.209
8	28.885	18	28.960	28	29.045	38	29.127	48	29.217
9	28.890	19	28.970	29	29.052	39	29.137	49	29.225

[1] U. S. Treas. Dept. Bull. No. 12, 1924, pp. 136–147.
[2] U. S. Treas. Dept. Bull. No. 13, 1925 ,pp. 67–69.

Reading	Salinity	Reading	Salinity	Reading	Salinity	Reading	Salinity	Reading	Salinity
50	29.233	135	29.989	220	30.765	305	31.580	390	32.397
51	29.240	136	29.998	221	30.775	306	31.589	391	32.406
52	29.250	137	30.007	222	30.785	307	31.599	392	32.416
53	29.260	138	30.015	223	30.794	308	31.607	393	32.426
54	29.270	139	30.024	224	30.804	309	31.617	394	32.435
55	29.278	140	30.033	225	30.814	310	31.628	395	32.445
56	29.285	141	30.045	226	30.824	311	31.637	396	32.455
57	29.295	142	30.051	227	30.833	312	31.646	397	32.465
58	29.304	143	30.059	228	30.843	313	31.656	398	32.475
59	29.313	144	30.068	229	30.853	314	31.666	399	32.484
60	29.321	145	30.077	230	30.863	315	31.675	400	32.494
61	29.328	146	30.085	231	30.872	316	31.685	401	32.504
62	29.337	147	30.094	232	30.882	317	31.695	402	32.513
63	29.435	148	30.103	233	30.892	318	31.704	403	32.522
64	29.355	149	30.111	234	30.901	319	31.714	404	32.537
65	29.364	150	30.120	235	30.911	320	31.724	405	32.542
66	29.373	151	30.129	236	30.920	321	31.733	406	32.551
67	29.383	152	30.138	237	30,930	322	31.743	407	32.560
68	29.392	153	30.146	238	30.939	323	31.752	408	32.571
69	29.403	154	30.155	239	30.949	324	31.762	409	32.580
70	29.410	155	30.164	240	30.959	325	31.771	410	32.589
71	29.419	156	30,172	241	30.969	326	31.781	411	32.598
72	29.428	157	30.181	242	30.978	327	31.791	412	32.607
73	29.437	158	30.190	243	30.988	328	31.800	413	32.616
74	29.446	159	30.199	244	30.997	329	31.810	414	32.627
75	29.455	160	30.208	245	31.006	330	31.820	415	32.637
76	29.464	161	30.217	246	31.016	331	31.829	416	32.646
77	29.473	162	30.226	247	31.026	332	31.838	417	32.656
78	29.482	163	30.235	248	31.035	333	31.848	418	32.665
79	29.491	164	30.244	249	31.045	334	31.857	419	32.676
80	29.500	165	30.253	250	31.055	335	31.866	420	32.684
81	29.509	166	30.262	251	31.065	336	31.877	421	32.692
82	29.518	167	30.271	252	41.075	337	31.886	422	32.702
83	29.527	168	30.280	253	31,084	338	31.896	423	32.713
84	29.536	169	30.289	254	31.094	339	31.906	424	32.723
85	29.545	170	30.298	255	31.103	340	31.915	425	32.732
86	29.554	171	30.307	256	31.113	341	31.925	426	32.742
87	29.563	172	30.317	257	31.122	342	31.935	427	32.752
88	29.572	173	30.326	258	31.132	343	31.945	428	32.762
89	29.581	174	30.336	259	31.142	344	31.955	429	32.772
90	29.590	175	30.345	260	31.152	345	31.964	430	32.780
91	29.599	176	30.354	261	31.162	346	31.974	431	32.789
92	29.608	177	30.363	262	31.172	347	31.984	432	32.799
93	29.617	178	30.372	263	31.181	348	31.993	433	32.808
94	29.626	179	30.382	264	31.191	349	32.003	434	32.819
95	29.635	180	30.392	265	31.200	350	32.013	435	32.828
96	29.644	181	30.401	266	31.209	351	32.022	436	32.837
97	29.653	182	30.410	267	31.219	352	32.032	437	32.847
98	29.662	183	30.419	268	31.228	353	32.041	438	32.857
99	29.687	184	30.428	269	31.238	354	32.051	439	32.867
100	29.680	185	30.437	270	31.248	355	32.061	440	32.876
101	29.689	186	30.446	271	31.258	356	32.071	441	32.886
102	29.698	187	30.456	272	31.267	357	32.080	442	32,896
103	29.706	188	30.465	273	31.277	358	32.090	443	32.905
104	29.715	189	30.475	274	31.287	359	32.100	444	32.916
105	29.724	190	30.485	275	31.296	360	32.110	445	32.925
106	29.732	191	30.494	276	31.306	361	32.119	446	32.934
107	29.741	192	30.503	277	31.315	362	32.129	447	32.943
108	29.750	193	30.512	278	31.325	363	32.138	448	32.953
109	29.759	194	30.521	279	31.335	364	32.148	449	32.963
110	29.767	195	30.530	280	31.345	365	32.157	450	32.972
111	29.775	196	30.539	281	31.354	366	32.166	451	32.982
112	29.784	197	30.548	282	31.364	367	32.176	452	32.992
113	29.793	198	30.557	283	31.373	368	32.187	453	33.001
114	29.810	199	30.566	284	31.383	369	32.197	454	33.011
115	29.810	200	30.575	285	31.392	370	32.206	455	33.021
116	29.819	201	30.585	286	31.401	371	32.215	456	33.030
117	29.828	202	30.594	287	31.411	372	32.225	457	33.040
118	29.837	203	30.604	288	31.420	373	32.235	458	33.050
119	29.845	204	30.613	289	31.430	374	32.245	459	33.061
120	29.855	205	30.622	290	31.440	375	32.255	460	33.069
121	29.863	206	30.632	291	31.449	376	32.264	461	33.077
122	29.871	207	30.641	292	31.458	377	32.274	462	33.087
123	29.880	208	30.650	293	31.467	378	32.283	463	33.098
124	29.887	209	30.660	294	31.476	379	32.293	464	33.107
125	29.895	210	30.670	295	31.485	380	32.302	465	33.117
126	29.913	211	30.679	296	31.494	381	32.311	466	33.127
127	29.921	212	30.689	297	31.503	382	32.320	467	33.137
128	29.929	213	30.698	298	31.512	383	32.330	468	33.147
129	29.937	214	30.708	299	31.521	384	32.340	469	33.156
130	29.945	215	30.717	300	31.530	385	32.349	470	33.166
131	29.954	216	30.721	301	31.540	386	32.359	471	33.176
132	29.963	217	30.736	302	31.551	387	32.368	472	33.186
133	29.972	218	30.746	303	31.562	388	32.378	473	33.196
134	29.980	219	30.755	304	31.571	389	32.388	474	33.206

Reading	Salinity	Reading	Salinity	Reading	Salinity	Reading	Salinity	Reading	Salinity
475	33.215	537	33.829	599	34.460	661	35.115	723	35.777
476	33.225	538	33.840	600	34.470	662	35.126	724	35.789
477	33.235	539	33.850	601	34.480	663	35.137	725	35.799
478	33.245	540	33.860	602	34.490	664	35.147	726	35.810
479	33.255	541	33.870	603	34.500	665	35.158	727	35.821
480	33.265	542	33.880	604	34.511	666	35.169	728	35.833
481	33.275	543	33.890	605	34.521	667	35.180	729	35.844
482	33.285	544	33.900	606	34.531	668	35.190	730	35.854
483	33.295	545	33.910	607	34.542	669	35.201	731	35.864
484	33.305	546	33.920	608	34.553	670	35.211	732	35.875
485	33.315	547	33.930	609	34.564	671	35.221	733	35.886
486	33.325	548	33.941	610	34.575	672	35.232	734	35.897
487	33.335	549	33.952	611	34.583	673	35.242	735	35.909
488	33.345	550	33.962	612	34.593	674	35.252	736	35.920
489	33.355	551	33.972	613	34.606	675	35.263	737	35.932
490	33.365	552	33.982	614	34.616	676	35.273	738	35.944
491	33.374	553	33.992	615	34.626	677	35.284	739	35.955
492	33.384	554	34.002	616	34.636	678	35.295	740	35.965
493	33.393	555	34.012	617	34.647	679	35.306	741	35.975
494	33.403	556	34.022	618	34.659	680	35.316	742	35.985
495	33.413	557	34.031	619	34.670	681	35.326	743	35.997
496	33.422	558	34.042	620	34.680	682	35.336	744	36.009
497	33.432	559	34.052	621	34.690	683	35.347	745	36.019
498	33.442	560	34.062	622	34.700	684	35.359	746	36.028
499	33.451	561	34.070	623	34.711	685	35.370	747	36.040
500	33.461	562	34.081	624	34.722	686	35.380	748	36.055
501	33.470	563	34.091	625	34.733	687	35.391	749	36.070
502	33.480	564	34.102	626	34.743	688	35.401	750	36.080
503	33.490	565	34.112	627	34.754	689	35.412	751	36.090
504	33.500	566	34.122	628	34.765	690	35.424	752	36.102
505	33.509	567	34.132	629	34.775	691	35.434	753	36.115
506	33.519	568	34.143	630	34.785	692	35.444	754	36.129
507	33.530	569	34.153	631	34.796	693	35.455	755	36.140
508	33.540	570	34.163	632	34.806	694	35.466	756	36.153
509	33.550	571	34.173	633	34.816	695	35.477	757	36.166
510	33.559	572	34.183	634	34.827	696	35.488	758	36.177
511	33.568	573	34.193	635	34.837	697	35.499	759	36.192
512	33.577	574	34.203	636	34.848	698	35.510	760	36.204
513	33.587	575	34.214	637	34.859	699	35.521	761	36.216
514	33.597	576	34.224	638	34.870	700	35.532	762	36.228
515	33.607	577	34.234	639	34.880	701	35.542	763	36.243
516	33.617	578	34.244	640	34.890	702	35.553	764	36.256
517	33.626	579	34.254	641	34.901	703	35.564	765	36.271
518	33.637	580	34.264	642	34.912	704	35.575	766	36.285
519	33.647	581	34.273	643	34.922	705	35.586	767	36.297
520	33.657	582	34.284	644	34.933	706	35.596	768	36.314
521	33.666	583	34.294	645	34.943	707	35.607	769	36.328
522	33.676	584	34.305	646	34.954	708	35.617	770	36.345
523	33.686	585	34.315	647	34.965	709	35.629	771	36.359
524	33.697	586	34.325	648	34.976	710	35.640	772	36.370
525	33.707	587	34.335	649	34.987	711	35.650	773	36.386
526	33.717	588	34.346	650	34.998	712	35.661	774	36.403
527	33.727	589	34.356	651	35.007	713	35.671	775	36.425
528	33.738	590	34.367	652	35.017	714	35.682	776	36.438
529	33.748	591	34.377	653	35.028	715	35.691	777	36.457
530	33.758	592	34.387	654	35.040	716	35.702	778	36.477
531	33.768	593	34.398	655	35.051	717	35.713	779	36.502
532	33.778	594	34.409	656	35.061	718	35.724	800	36.500
533	33.789	595	34.419	657	35.071	719	35.735		
534	33.799	596	34.430	658	35.085	720	35.746		
535	33.809	597	34.439	659	35.095	721	35.755		
536	33.819	598	34.449	660	35.105	722	35.766		